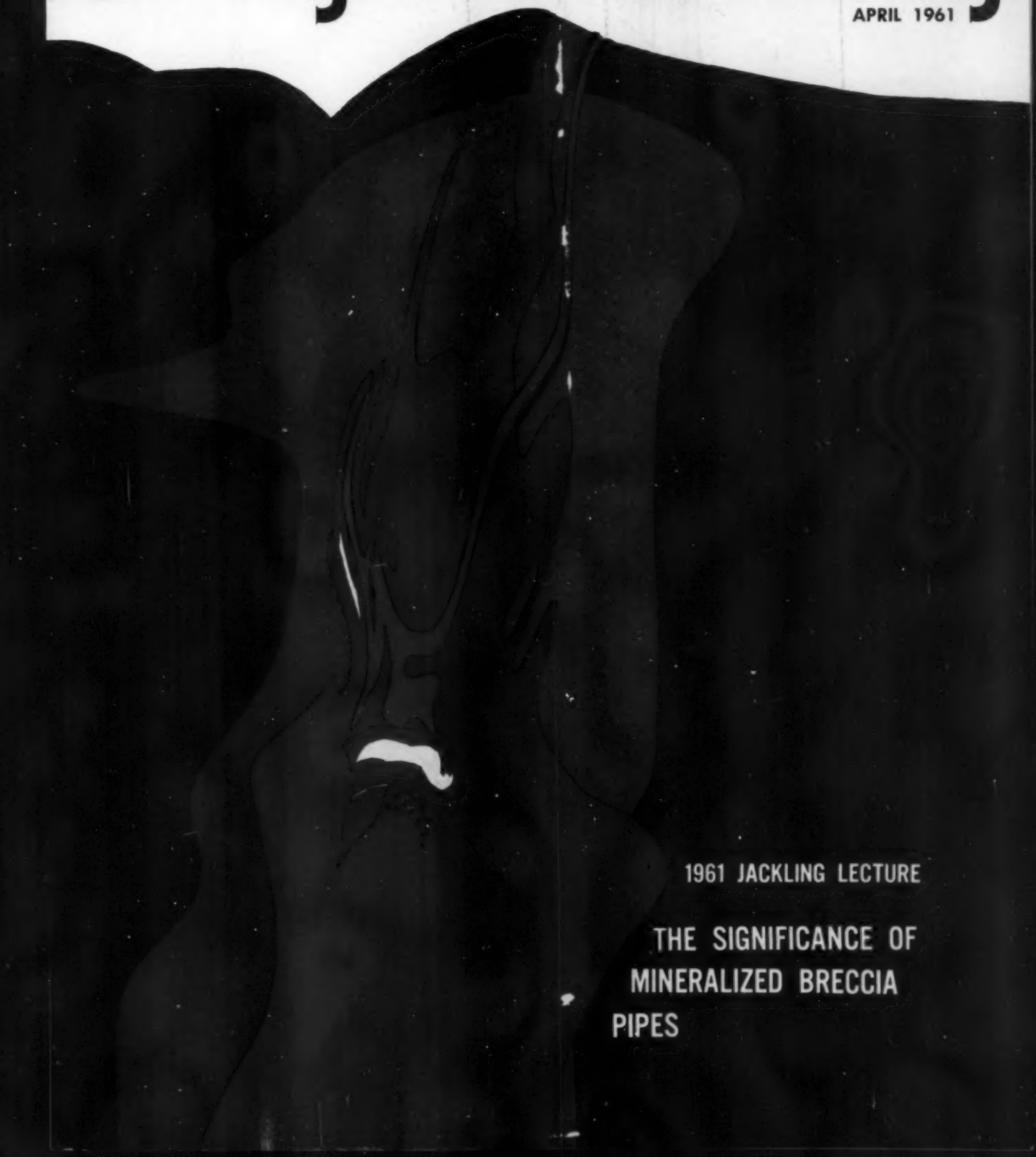
MINING engineering

APRIL 1961



1961 JACKLING LECTURE

THE SIGNIFICANCE OF MINERALIZED BRECCIA PIPES

LOWER Pumping Costs • HIGHER Output • LONGER Pump Life

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Wilfley Acid Pumps

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Wherever you find Wilfley Sand Pumps, you find money-saving performance. Rugged construction and simplified packingless design guarantee 24 hour service without attention. Wilfley's quick-change features allow speedy replacement of worn parts.

Wilfley offers you a wide range of sizes and capacities. Long-wearing parts, few in number, are constructed of the best alloy metal or rubber-compound for your service.

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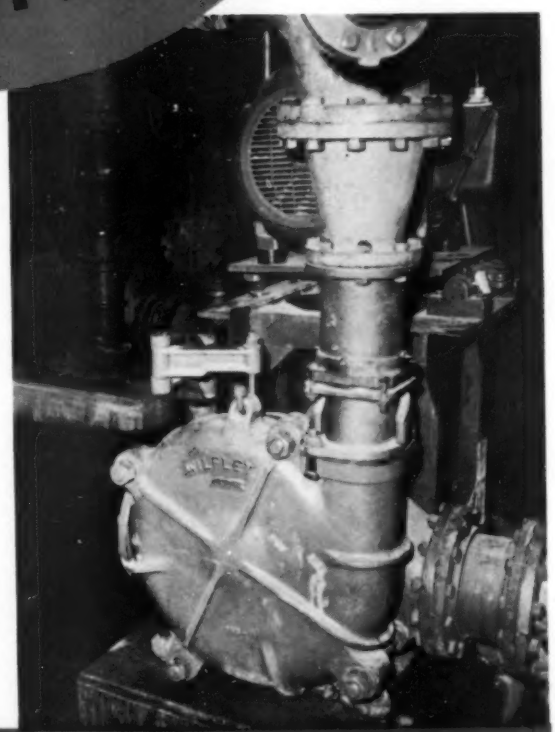

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Circle No. 1 on the reader service card.

COMING EVENTS

Apr. 24-25, AIME Southwest Minerals Industry Conference, sponsored by SME Industrial Minerals Division and AIME Nevada Section. Stardust Hotel, Las Vegas, Nev.

Apr. 26-27, AIME Technical Conference on High-Temperature Materials, Carter Hotel, Cleveland.

May 7-11, ASME—Engineering Institute of Canada Hydraulic Conference, Queen Elizabeth Hotel, Montreal.

May 12-14, Sixth Annual Uranium Symposium, sponsored by AIME Central New Mexico Section, Grants, N. M.

May 15-18, Coal Show of the American Mining Congress, Cleveland. Suggestions for topics to be included in program should be sent to American Mining Congress, Ring Bldg., Washington 6, D. C.

May 17-19, First Conference on Management of Materials Research, sponsored by The Metallurgical Society of AIME. Arden House, Harriman, N. Y.

May 20, AIME Colorado MBD Subsection annual meeting with technical papers, Broadmoor Hotel, Colorado Springs, Colo.

May 25-26, 37th Annual Conference, Lake Superior Mines Safety Council, Hotel Duluth, Duluth, Minn.

June 2-3, Spring Meeting of the Central Appalachian Section, AIME, Campbell House, Lexington, Ky.

June 6-8, Sixth Annual Appalachian Underground Corrosion Short Course, West Virginia University School of Mines, Morgantown, W. Va. For information write John H. Alm, Publicity Chairman, Dearborn Chemical Co., 2 Gateway Center, Pittsburgh 22, Pa.

June 6-8, National Coal Assn., 44th Annual Meeting, Mayflower Hotel and Coal Bldg., Washington, D. C.

June 12-July 21, Eleventh Annual Short Course in Coal Preparation, West Virginia University School of Mines, Morgantown, W. Va.

June 28-30, ASME—University of Colorado Joint Automatic Control Conference, University of Colorado, Boulder, Colo.

July 27-29, Seventh Annual Institute, Rocky Mountain Mineral Law Foundation, Albuquerque, N. M.

Aug. 28-Sept. 1, ASME—University of Colorado International Heat Transfer Conference, University of Colorado, Boulder, Colo.

Sept. 11-14, American Mining Congress Metal Mining—Industrial Minerals Convention, Seattle, Wash.

Sept. 17-20, Commemoration of the 50th Anniversary of Froth Flotation in the U.S.A., sponsored by AIME: Society of Mining Engineers' Minerals Beneficiation Division, Brown Palace and Cosmopolitan Hotels, Denver.

Oct. 2-3, Joint Meeting, Industrial Minerals Division of SME of AIME—CIM, Ottawa.

Oct. 5-7, AIME-ASME Joint Solid Fuels Conference, Birmingham.

Oct. 18-21, AAPG Mid-Continent Regional Meeting, Amarillo, Texas.

Nov. 1-3, Southwestern Federation of Geological Societies Fourth Annual Meeting, El Paso, Texas.

Nov. 3-4, Joint Meeting Central Appalachian Section, AIME and the West Virginia Coal Mining Institute, The Greenbrier, White Sulpher Springs, W. Va.

Nov. 3, Pittsburgh Sections of AIME and NOHC Off-the-Record Meeting, Penn-Sheraton Hotel, Pittsburgh.

Dec. 4, Annual Meeting Arizona Section of AIME, Pioneer Hotel, Tucson, Ariz.

Dec. 6-8, Nineteenth Electric Furnace Conference, sponsored by the Metallurgical Society of AIME. Penn-Sheraton Hotel, Pittsburgh.

MINING engineering

VOL. 13 NO. 4 **APRIL 1961**

COVER *Mineralized Breccia Pipes—relatively uncommon geologic features related to the relatively uncommon great mines of the world. Artist Herb McClure has added color to the cross-section of La Colorada breccia pipe, one of the many discussed in the 1961 JACKLING LECTURE, "The Significance of Mineralized Breccia Pipes" by Vincent D. Perry which appears in this issue on page 367.*

ARTICLES

PLUS

DEPARTMENTS

FEATURED ITEMS

MINING ENGINEERING staff, Society of Mining Engineers, and AIME Officers are listed on the *Drift* page.

Address insertion orders and copy to MINING ENGINEERING, 29 W. 39th St., New York 18, N. Y. Send plates to: MINING ENGINEERING, c/o Law A. Cummings Co. Inc., 215 Canal St., Manchester, N. H. Published monthly by the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 29 W. 39th St., New York 18, N. Y. Telephone: PEnnsylvania 6-9220; TWX NY 1-1304. Subscription $8 per year for non-AIME members in the U. S., & North, South, & Central America; $10 all other countries; $6 for AIME members, or $4 additional for members only in combination with a subscription to "Journal of Metals" or "Journal of Petroleum Technology". Single copies, $.75; single copies foreign, $1.00; special issues, $1.50. AIME is not responsible for any statement made or opinion expressed in its publications.

Registered cable address, AIME, New York. Indexed in Engineering Index, Industrial Arts Index, and by National Research Bureau. Second class postage paid at New York, N. Y., and at Manchester, N. H. Number of copies printed of this issue 15,700.


12 P&H ELECTRICS IN THIS COPPER MINE PERU
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7 P&H ELECTRICS IN THIS ASBESTOS MINE CANADA
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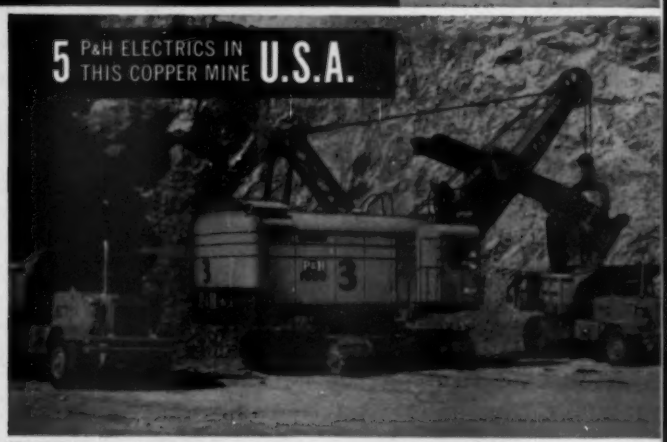
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Throughout the Americas...

More mines are STANDARDIZING on P&H ELECTRIC SHOVELS

...more evidence that one P&H always sells another

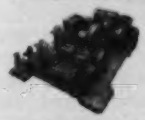
Look at the evidence: Count the P&H Electric Shovels now in use in each of the mines shown here. It's the same story you'll find in mine after mine: once a P&H electric shovel is on the job, performance records show production increases and lower unit costs that simply make it good business to standardize on P&H. Because more mines are following this trend, Harnischfeger now is the world's largest builder of full electric and diesel-electric shovels.

P&H Electric Shovels incorporate many dramatic new design fundamentals which make them different from all others.

Foremost is MAGNETORQUE® drive—the exclusive *patented* hoist drive that puts more material into the dipper, faster—with every pass! It is the most productive digging motion drive known for electric shovels, producing higher bail pull, greater dipper fill factor and automatic impact protection for the hoist machinery.

FIVE EXCLUSIVE P&H FEATURES

MAGNETORQUE DRIVE
Electro-magnetically transmits full digging power of A.C. motor direct to dipper—without motor generator set conversion to D.C. current.



FULL WELDED STEEL CONSTRUCTION
Unit-welded rolled steel design pays dividends in exceptionally long shovel life in hard digging.

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No open gearing—all power trains for hoist, swing and propel drives are enclosed in oil-tight gear cases.

INDEPENDENT CRAWLER PROPEL MOTION
P&H gives you independent motors for each function—the basic principle of electric shovel design and purpose.

HIGH STRENGTH T-1 STEEL
Only Harnischfeger uses it as *standard* in fabricating a boom and dipper handle with highest impact absorption ability.

Another major reason why "One P&H Always Sells Another" is single-source responsibility for service. Harnischfeger is the only shovel manufacturer which makes its own electrical as well as mechanical components—all designed and matched by a single manufacturer *specifically for balanced electric shovel production cycles.* For more information write Harnischfeger Corporation, Milwaukee 46, Wisconsin.

HARNISCHFEGER
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P&H
CONSTRUCTION & MINING DIVISION

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Permanent positions in old established, growing industry. Small rapidly growing community with invigorating smog-free climate. Salary open. Good fringe benefits.

Send resume to:

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PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This service, which cooperates with the national societies of Civil, Chemical, Electrical, Mechanical, Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number. When making application for a position include 8¢ in stamps for forwarding application. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance. Local offices of the Personnel Service are at 8 W. 40 St., **New York 18;** 57 Post St., **San Francisco;** 29 E. Madison St., **Chicago 1.**

In addition to the listings below, ESPS maintains a more complete file of general engineering positions and men available. Contact nearest ESPS office, listed above.

WANTED

For one to two years assignment in Far East

MINING ENGINEER with experience in design, construction, shaft sinking, and mining highly inclined seams.

MECHANICAL ENGINEER with design and construction experience preferably on mining projects.

ELECTRICAL ENGINEER with design and construction experience preferably on mining projects.

SHAFT SINKING FOREMAN—must have had responsible charge of major project with concrete lining and grouting.

Send full record to:

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29 W. 39th St., New York 18, N. Y.

MEN AVAILABLE

Mine Foreman or Assistant Mine Superintendent, M. E. degree. Twelve years mine production, block caving system, also shrinkage, cut and fill, square setting; familiar with tin, gold, lead, and zinc, fluorspar mines. Ability to handle men—efficiency. Prefer foreign location, M-601.

Mine Superintendent, graduate engineer with extensive open pit mining experience, engineering, maintenance, planning, crushing and screening plant, also underground experience. Desires to locate in continental U.S., married, 39, available 3-4 months. M-602.

Geologist-Petrographer, M.S. degree. Two years experience in petrographic analysis plus experience in geophysics and petroleum geology. Interested in employment as geologist and/or mineralogist and petrographer. M-600.

Jr. Geologist, B.S. geological engineering, age 22. Six months with seismic survey contractor as junior computer. Location open. M-2090-Chicago.

(Continued on page 320)

RHOANGLO MINE SERVICES LIMITED, KITWE, NORTHERN RHODESIA

SENIOR MINERALOGIST • MINERALOGIST

Applications are invited from qualified mineralogists for posts in the Mineralogical Section of the Research and Development Division, Kitwe, which undertakes a wide range of projects in extraction metallurgy for the Rhodesian Companies of the Anglo American Corporation of South Africa, Limited. These vacancies are the result of promotions and expansion.

Facilities in the Mineralogical Section include X-Ray diffraction equipment, projection microscope and infrasizing and superpanning equipment as well as the usual microscopes, photographic facilities and sample preparation equipment. Analytical services are available.

Applicants for the post of Mineralogist should have had some experience in determinative mineralogy and in petrology. The Senior Mineralogist, who would report directly to the Assistant Superintendent of the Division, should have sound experience in the above fields and the ability to co-ordinate and supervise the work of a team of three mineralogists. He would also be required to liaise with geologists and research and plant personnel on mineralogical problems. A knowledge of mineral concentration techniques would be an advantage.

The commencing basic salaries for these positions will be determined by qualifications and experience but will not be less than:-

Senior Mineralogist	£1,587 (Stg) per annum
Mineralogist	£1,191 (Stg) per annum

In addition to the basic salary, both positions carry a bonus varying with the prosperity of the copper-mining industry (at present about 40% of basic salary) and a variable cost of living allowance (currently about £62 per annum). There are also generous pension, life assurance and medical benefits and a low rate of income tax. Air or sea passage for the successful candidates would be paid by the Company and, dependent upon the point of entry into the salary range, assistance would be provided towards importation expenses.

Kitwe in Northern Rhodesia is situated on the Central African Plateau at an altitude of 4,100 feet above sea level and consequently enjoys an equable healthy climate of dry winters with a rainy season moderating summer temperatures.

Ample all the year round facilities for all the usual sports are available and the generous leave allowance together with excellent rail, road and air communications permits long leaves to be spent at either various coastal resorts or abroad. Leave may be accumulated for up to three years and varies between 48 and 51 days per annum depending on salary.

Housing provided complete with basic furniture, refrigerator etc. is of excellent standard and provided with all modern amenities at a nominal rental and African domestic labour is readily available.

Replies, stating age, marital status, qualifications, experience record, and availability, together with names of two referees, and a recent photograph, should be addressed by airmail to:

The Secretaries, P. O. Box 172
Kitwe, Northern Rhodesia

Only Spencer uses military type underwater tests to determine the relative effectiveness of commercial explosives. These tests are the latest in a continuing research program conducted by Spencer Chemical Company, the pioneer supplier of solid ammonium nitrate as an ingredient in blasting.

Precise new underwater testing method shows . . .

Spencer N-IV And Fuel Oil Produces Up To 7 Times As Much Useful Energy Per Dollar

. . . when compared with gelatin dynamites

How do you measure the true blasting effectiveness of commercial explosives? Unsatisfied with present methods, Spencer Chemical Company and a well known research organization teamed up to discover a better way.

After extensive investigation Spencer adopted underwater testing methods developed through military research. These were found to provide data better related to commercial blasting than any other testing method. As a result, more accurate standards of evaluating the actual useful output of explosives have been developed.

Latest test results show that Spencer N-IV Ammonium Nitrate and fuel oil deliver up to seven times as much useful energy per dollar as gelatin dynamites (see chart at right).

Extensive research has also shown that Spencer N-IV, when mixed with the recommended 6% fuel oil, delivers 20% to 25% more blast energy than equal charges of other solid ammonium nitrate-fuel oil mixtures. There are two main reasons for this: (1) lower density which provides greater ease of detonation, (2) special prill structure which allows fuel oil to be absorbed more evenly.

It costs you nothing to get the full benefits of Spencer's advanced knowledge and experience in this field. Just mail this coupon. No obligation of course.

PERFORMANCE COMPARISON OF BLASTING MATERIALS

Explosive	Heaving Energy Ft. Tons/Lb.	Shattering Energy Ft. Tons/Lb.	Effective Energy Ft. Tons/Lb.	Useful Energy Ft. Tons/$
Spencer N-IV and Fuel Oil	423	60	483	14,230
40% Gelatin Dynamite	257	115	372	1,770
60% Gelatin Dynamite	384	84	468	1,800

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Without cost or obligation, please send me the latest information on the use of Spencer N-IV and fuel oil for blasting.

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BOOKS

Arizona: Its People and Resources, edited by Jack L. Cross, *The University of Arizona Press.* Tucson, Ariz., 378 pp., $6.50, 1960—This book, termed the most comprehensive volume ever written about Arizona, covering the state's history, resources, government, economy, and culture. The work of 78 contributing authors, all authorities in their respective fields, it offers an overall view of the state's colorful record from the time of its prehistoric Indian residents to present-day prominence in the national scene. Among those contributing chapters is James D. Forrester, dean of the University's College of Mines and a member of SME.

Proceedings of Hungarian Mining Congress—1960, *Kultura,* Budapest 62, P.O.B. 149, Hungary, 1960, 4 vol., approx. 1600 pp., about $20.00—This book contains all the material in the papers read at the International

(Continued on page 335)

PERSONNEL

(Continued from page 318)

Geologist-Mining Engineer, B.S. geological engineering, age 32. Eight years experience in West and Midwest base-metal mines. Mine grade control, mine development, diamond drill planning and supervision. Location open. M-2095-Chicago.

POSITIONS OPEN

Mining Engineer, graduate, to assist mine superintendent in all phases of open pit mining operations. Will consider inexperienced mining engineer who is willing to work and learn. South. W75(a).

Mining Engineer capable of making mine studies and reports on the quality of minerals, reserve supply, problems, involved in mining and transporting. Must be able to make feasibility and proof reports. $14,000 to $16,000. Considerable foreign travel. Headquarters, eastern U.S. W39.

Technical Products Sales Engineer to sell flocculents, mining and settling reagents. Some background as mill superintendent or mill engineer in ore beneficiation. $10,000 to $12,000. New York City. W9931.

Chief Engineer for process design, plant design, new plant construction and supervision of office for large operation of mining company engaged in phosphate rock mining and processing. Operations cover strip mining, hydraulic transportation, washing and screening plants, flotation plants, drying mill, grinding plant and calcine plant. South. W9721.

Mill Superintendent who has had experience with large scale operation. Pennsylvania. W9696.

Assistant Mine Manager, for fluorspar mine, graduate mining engineer, about 40, familiar with mining and milling, flotation, medium size mill. Must know shaft sinking, stoping, etc. Salary open. Newfoundland. F9275.

Now, load faster, more safely than ever before . . .

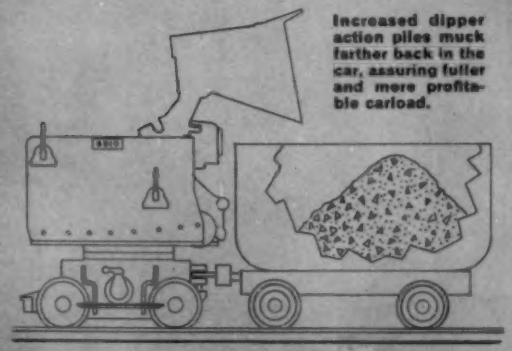
NEW GARDNER-DENVER "WORK

MODEL GD18

SPECIFICATIONS

Clean-up width	105"
Track gauge	18" to 36"
Weight—Standard	7530 lb.
High	7950 lb.
Dipper capacity	9 cu. ft.
Traction motor hp	15 at 90 psi
Dipper motor hp	17 at 90 psi
Necessary air pressure	50-100 psi
Size air connection	1½"

MORE PAY LOAD



Increased dipper action piles muck farther back in the car, assuring fuller and more profitable carload.

HORSE" MINE CAR LOADER

4 BIG REASONS WHY THE GD18 IS YOUR BEST BUY—ANYWHERE

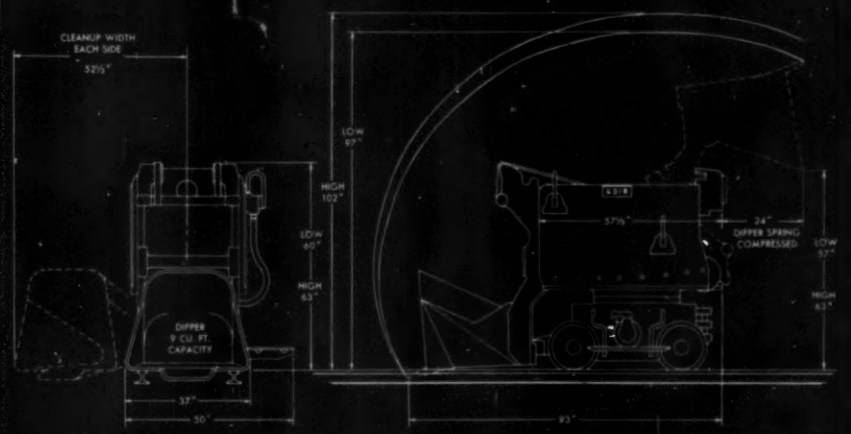
MORE POWER—Highly increased dipper and traction motor hp. And you can use every bit of it. Weight distribution and force leverages are balanced with this extra hp.

UNMATCHED PERFORMANCE—Faster loading rate per car—proved by actual competitive tests in iron ore at any pressure from 50 to 100 psi. You get more tons per carload—increased dipper power throws muck peak farther back in the car.

PROVED RELIABILITY—Years of extensive field testing *proved* the design . . . *proved* low operating and maintenance costs . . . *proved* increased production with fewer delays.

MAXIMUM SAFETY—Excellent weight distribution provides stability regardless of track gauge—better than any other loader. Reliable centralizing and minimum effort, required to position dipper, safeguard operator . . . enable him to get high performance with ease.

DIMENSIONS



OTHER FEATURES

- Smooth, positive centralizer action
- Easily converted to high or low construction
- Traction and dipper motors have same internal parts
- Five-cylinder radial air motors
- Three-point lubrication
- Crown-shaved gears
- Single, enclosed shock spring for dipper
- Steel wheels
- Unitized component assemblies—interchangeable
- Self-cleaning dipper arm guides

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NEWS FROM MINE AND MILL

LIQUID SULFUR SHIPMENT

Freeport Sulphur Co. has completed the largest shipment of liquid sulfur via ocean-going vessel in the history of the industry.

A record 16,100 long tons of molten sulfur, kept hotter than boiling water en route, was transported by the vessel Louisiana Sulphur from Port Sulphur, La. to Tampa, Fla. The trip marked the inauguration of the coastwide tanker service which is part of a new $23 million program to move the company's sulfur in liquid form into major market areas for storage and trans-shipment to its customers.

UTAH POTASH PROJECT

Texas Gulf Sulphur Co., the world's largest sulfur producer, plans to spend $30 million on a new potash mining and processing plant now getting underway in southeastern Utah near the town of Moab. Construction has begun on the mine shaft, and the plant is scheduled to begin operations by the end of 1962. The plant is designed to produce at the outset 1,100,000 tons of muriate of potash annually, a capacity greater than the current output of any domestic producer. This project, representing the company's first major move toward diversification, is expected to be financed entirely out of retained earnings.

AERIAL SURVEY IN JORDAN

Maps and photos of the ancient desert land of Jordan will be produced from an aerial survey by Aero Service Corp. About 30,000 square miles of the Hashemite Kingdom of Jordan will be mapped from a height of six miles. This $760,000 project is being financed by the U.S. International Cooperation Administration.

The aerial photography will aid new mineral and petroleum studies and serve as source material for topographic maps to facilitate highway location and general planning.

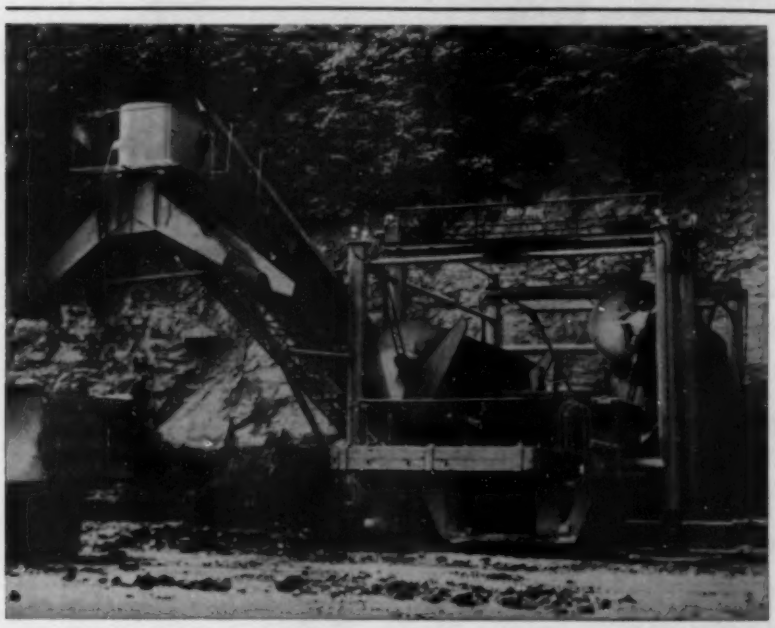
The air crews will use new mapping cameras capable of recording some 200 square miles on a single nine by nine inch negative. More than 900 overlapping air photos of the survey will be obtained in less than a month.

First maps will be delivered early in 1963. A total of 147 map sheets, at a scale of 1:50,000 with 20 meter contours, will be delivered by the end of the year. Each 22 x 29 in. map printed in four colors, will cover 250 square miles.

KERR-McGEE EXPANDS

Kerr-McGee Oil Industries, Inc., through an exchange of stock of its subsidiary, Kermac Nuclear Fuels Corp., has acquired all of the capital stock of Lakeview Mining Co. and Gunnison Mining Co. Both companies have AEC contracts.

The Lakeview-Gunnison acquisition is a part of the company's plan to diversify and expand its operation in the mineral industry by acquiring strategically located chemical processing facilities. These chemical processing plants can be used for treating and concentrating raw materials other than uranium and are favorably located for this purpose.



GIANT AUGER USED AT KENTUCKY MINE

The world's largest coal auger is greatly responsible for the fast rate of production of steam-grade coal on the Kentucky Oak Mining Co. property of R. H. Kelly and W. B. Sturgill near Hazard, Ky.

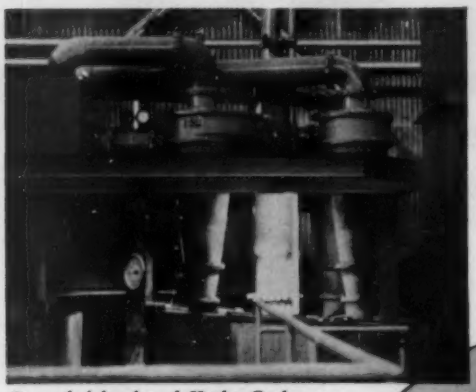
The huge auger, with a cutting head seven feet in diameter, was developed by Compton, Inc., a subsidiary of Joy Manufacturing Co. The machine, given a rated production capacity of 15 tpm of coal, has produced as much as 25½ tpm in actual operation. The standard penetrating speed of the auger is 10 fpm, but a speed of 17 fpm has been achieved by using cemented carbide tip bits having a speed of 1100 fpm.

The machine is equipped with seven 30-ft-long sections of auger and can penetrate 216 ft into a coal seam. Power for the machine is supplied by a 700 hp diesel engine which rotates and thrusts the cutting head and one section of auger into the coal seam to start the boring operation. The auger spirals force the coal from the hole on to a conveyor belt which carries it to waiting trucks. The conveyor belt is equipped with a hydraulically controlled divided chute which permits one truck to be loaded while another is getting into loading position.

Only one-half minute is required to halt drilling, lower a new auger section into position, and resume drilling. After a hole is finished it takes four to eight minutes to withdraw the auger section, rack it up in the machine frame, move the machine by means of hydraulic walkers to a new position, and continue drilling. Standard procedure at the Hazard mine is to leave 10 to 12 in. of coal between each hole as roof support.

In addition to the 70 miles of outcropping presently being mined, Kentucky Oak Mining Co. holds mineral rights to an adjacent 70 miles of coal in the same seam. Two other mineable seams on the same property contain 140 million tons of coal, making a total reserve of about 300 million tons of steam-grade coal, from this and nearby properties owned by Kelly and Sturgill.

Each KREBS CYCLONE handles 2,050,000 tons of primary ball mill discharge with *Original liner!*



One of 4 banks of Krebs Cyclones (4 in each bank) in primary closed-circuit grinding operation at Silver Bell unit of American Smelting and Refining Company.

Krebs Cyclones are equipped with specially designed replaceable liners. Rubbers liners of pure gum or Neoprene are molded under extremely high pressure. This technique eliminates internal porosity, resulting in a rubber of greater density without reducing the resiliency. Correct fit of the liners is assured, and a smooth glassy surface is maintained for superior performance during the greatly extended wear life. Wear increases toward the apex of the conical section and for very abrasive slurries the lower cone and apex section are frequently lined with Refrax or other special material.

Detailed operating and metallurgical report of this operation are available upon request to Equipment Engineers Inc.

EQUIPMENT ENGINEERS INC.
737 LOMA VERDE AVENUE • PALO ALTO, CALIFORNIA

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PRODUCTS FOR MINE AND MILL

Rear-Dump Trailer

A 37 cu yd, variable wheel base, rear-dump trailer with a 55-ton capacity has been designed by *Easton Car & Construction Co.* The "TS-3755" has a special operating feature which enables the wheel base to shorten automatically as the body is raised to dump position thus permitting increased maneuverability in tight working areas. When in fully dumped position, the lip of the body then extends out beyond the tires thus providing ample clearance for free discharge of the load. This trailer is adaptable for use with any two-axle tractor but, since the overall dimensions of the trailer and the design of the draft beam for the universal hitch will vary according to each tractor, it will be built to order only. **Circle No. 76.**

Trailer Frames

A series of high-strength, aluminum frames for dumping trailers, tankers, and flatbed trailers has been introduced by *Ravens-Metal Products, Inc.* Adaptable for carrying any legal highway capacity, the BX frames are reportedly 50% lighter than steel frames of the same size. This frame is constructed with an I-beam which may be as deep as the anticipated cross load requires, and any length from 20 ft to 35 ft. **Circle No. 77.**

Convertible Timber Car

A timber car designed with separable trucks for either track or trackless mining has been introduced by *Vulcan Iron Works.* This car, which has an open end to accommodate various timber lengths, can be lowered down a shaft as a cage with or without the trucks. For trackless mining, this unit is wagon-rigged with a steerable front end and pneumatic tires. Use of this car eliminates the need for two complete loadings and thereby considerably reduces hoisting time. **Circle No. 78.**

Telephone-Loud Speaker

A transistorized unit which utilizes existing inter-plant or mine telephone lines has been developed by *Mine Safety Appliances Co.* Its primary uses are for calling over a loud speaker and for communicating semi-privately by telephone. Since ten or more units can be installed on a single line, paging can be accomplished at several points simultaneously. In answering, a lift of the handset transforms the "Pager" into a telephone. **Circle No. 79.**

Quick-Change Ripper Pins

Caterpillar Tractor Co. has announced a two-piece quick-changing pinning device for securing tips on No. 8 and No. 9 rippers. These pins reportedly can be changed within one minute. They are virtually unbreakable due to a through-hardening of the alloy steel forgings. The pins, semi-circular in diameter, are bent slightly at the center to achieve the locking effect and are flanged at each end. **Circle No. 80.**

Conveyor Scale

A conveyor scale which automatically weighs, measures, meters, and/or controls the flow of bulk materials on conveyor belts has been introduced by *Ramsey Engineering Co.* The *"Vey-R-Weigh"* is designed for control applications in operations where bulk materials are transported on conveyor galleries. The unit can be used for continuous product inventory, rationing or bleeding of additives, segregation control, bulk destiny determination, and grade or assay determination. Convenient adjustments for zero and calibration are contained within the instrument, and a range of capacities from 8.6 to 250 lb per foot of belt is available for standard models. **Circle No. 81.**

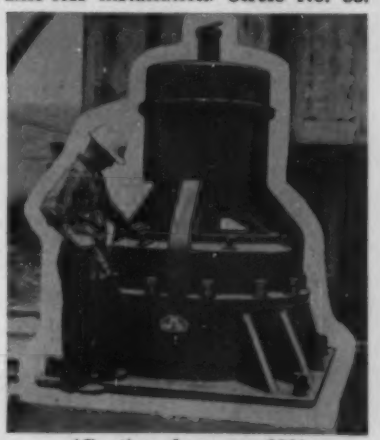
Vibrating Screens

Horizontal vibrating screens with integrally mounted motors have been made available by *Allis-Chalmers.* In this design, motor base and tubular cross member become an integral part of the horizontal screen's frame. Reported Advantages of this arrangement include: elimination of an overhead structure; reduced head room; increased belt life due to close fixed centers between motor and

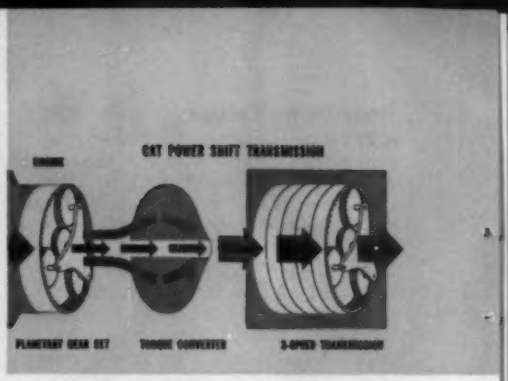
mechanism; shorter belts which overcome whipping wear; and elimination of the need for timing and motor alignments in the field. **Circle No. 82.**

Reduction Crusher

A completely hydraulic reduction crusher, the "Kone-O-Matic" by *Kennedy Van Saun Mfg. & Eng. Corp.*, offers important advantages in secondary and tertiary operations. Major features: lower feed opening; main shaft top-supported by multiple hydraulic cylinders; crusher setting automatically held in set position by a new control device; setting is easily varied; automatically rejects tramp iron without damage; gearless drive; pressurized lubrication; bowl liner and mantle precision machined for zinc-less installation. **Circle No. 83.**



(Continued on page 329)



The exclusive Cat power shift transmission works like this: The engine drives planetary gears in the flywheel, where output torque is divided. Part of it is routed to the transmission through a torque converter (providing anti-stall and load-matching ability). Part goes direct to the three-speed transmission (provides economy and fast response of direct drive). It's one ton of muscle built with the precision of a fine watch.

WITH CAT POWER SHIFT TRANSMISSION IN A D8H, A MAN'S FINGER TIPS CAN CONTROL 30-50% MORE PRODUCTION

Your present equipment may move material at low cost—but here's one reason a D8 Series H Tractor may move it a lot cheaper.

It's the Caterpillar power shift transmission—the only transmission available that combines the advantages of direct drive, torque converter drive and power shifting in a single unit. It greatly increases operator efficiency—offers important new opportunities for broadening your profit margin.

Here's how this big step ahead in transmission design helps your operator get more work from the machine: A single selector lever replaces the familiar master clutch, gear change and forward-reverse levers. Using this single selector lever, the operator can shift on the go in a split-second even under full load. He changes speed or reverses direction with finger-tip ease . . . without clutching . . . without braking . . . without even lifting his arm from the arm rest. And the lever is mounted for left-hand control, leaving the right hand free for maneuvering the tractor or controlling the dozer, ripper or scraper. Convenience makes it easy to choose the right speed at the right moment.

Matching this ease of control are safety features you'll like. A safety lock in the selector housing holds a parked machine in neutral while the engine is running. Another safety device automatically shifts the selector lever to neutral when the engine is stopped.

The simplicity and safety of the Cat power shift transmission make your good operators even better and less experienced operators more effective. They can take greater advantage of the tractor's power and capacity to speed the work. And ease of operation keeps their efficiency high throughout the day.

Cat power shift transmission also means a big jump in your machine's efficiency too. You'll particularly notice the difference on jobs where frequent shifting is the rule—such applications as feeding a shovel or short-cycle dozing.

For instance, in dozing, the operator starts to pick up the load in second gear—then shifts on the go to first for full lug yardage. There's no clutching, no lost time or momentum when changing speeds. An easy move back to second drifts the material to its destination. Another move of the lever puts the machine in high-speed reverse for fast return to the digging area.

Machine efficiency is *always* high. Cat power shift transmission provides the needed power at the highest possible speed. Its exclusive torque divider design combines the snap and economy of direct drive with the load-matching ability and anti-stall characteristics of torque converter drive—and three forward-reverse speeds tailor it to the entire working range.

Just how much of an increase will the Cat power shift transmission make on your job? This will depend on your application. On short-cycle dozing, reports in our file show increases *as high as 50%* over similar-sized machines with other transmissions. Some users flatly state they will never buy another track-type machine in the 200 HP class unless it is a Cat power shift unit.

Power shift transmission is just one reason the D8H may be a far better profit tool than the machine you are now using. There are other features of this 235 HP turbocharged tractor that could be equally advantageous in your work. Your Caterpillar Dealer will welcome the opportunity to discuss the D8H in terms of your job and present facts and figures so you can determine true benefits. And if a demonstration with measured results would help, he will be glad to make arrangements.

Call him today.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

CATERPILLAR

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STEP UP PRODUCTION AND PROFITS WITH POWER SHIFT TRANSMISSION

Circle No. 8 on the reader service card.

PRODUCTS
FOR MINE AND MILL

(Continued from page 327)

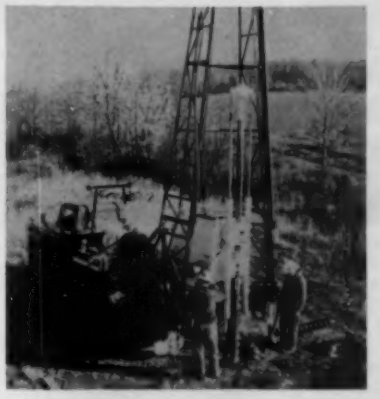
Coal Analyzing System

The *Netherlands State Mines*, in concert with *N.V. Nederlandse Rontgenapparatenfabriek Evershed- Enraf*, has developed an apparatus to determine the percentage of ash content in raw coal. The system can be installed directly at the coal washing operation and functions as follows: As raw coal is fed into the washing plant it is continually sampled. The samples are passed into a conditioning section where they are dried and ground, and are then fed onto a rotary disc. In a continuous operation the ground coal is exposed to X-ray beams which are reflected and measured photo-electrically. Coincidentally, this measurement is compared with that of a reference sample, and the results are recorded on tape. At the same time, a meter calibrated for ash content indicates the percentage constituency. This can be connected to an automatic control to interrupt the washing process if the quality of raw coal falls below standard. A further application of this device can be installed at the outflow end of the washing plant, where constant analysis of clean coal can be conducted and recorded. **Circle No. 84.**

Cascade Impactor

A cascade impactor, developed for efficient field sampling by the Health and Safety Laboratory of the U. S. Atomic Energy Commission, has been made available by the *Union Industrial Equipment Corp.* This unit facilitates accurate particle size analysis of almost all industrial atmospheres. A built-in slide movement mechanism permits the collection of eight times more sample on each stage than on a corresponding fixed collection surface. The calibration is based on microscopic sizing and is applicable to any flow rate between 2 and 40 lpm and any particle density between 0.8 and 20 gm/cc. **Circled No. 85.**

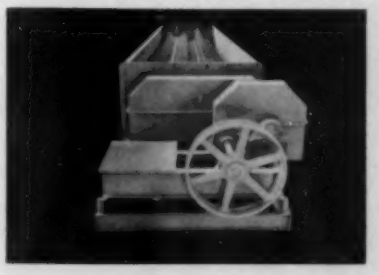
Core Drill And Auger



A heavy-duty, truck-mounted combination core drill and auger, called the "Acker SP," has been produced by *Acker Drill Co.* This rig handles diamond bit coring and auger boring for soil sampling, hollow stem augering, geophysical and geological exploration, water wells, and foundation borings. Features include: a four speed cathead hoist, four speed transmission, built-in reverse, and hydraulic drill heads. The unit is self-contained with its own power plant, built-in tool bins, water tank, and hydraulically-operated mast and leveling jacks. Capacities are: augering to 300 ft; core drilling to 1500 ft; holes up to 24-in. diam. It handles 5-ft hollow stem or conventional auger flights, and it is capable of drilling with roller, drag-type, and carbide bits as well as diamond bits. Full 360° operation permits oblique or vertical holes, and separate controls permit regulation of all operations independently. **Circle No. 86.**

Log Washer

McLanahan Corp. has recently expanded its line of Mudmaster log washers to include a 12-ft. log model. Developed for processing phosphate, this model is also recommended for gravel, crushed stone, manganese, and iron ores. This 12 in. x 30 ft long size makes possible a greater paddle arc, resulting in a greater cleaning action and larger output. Main components: heavy gauge, steel plate washer box with adjustable slope; square logs and paddles; hydraulic gudgeon; and cut tooth, spur gear drive train running in an oil bath. **Circle No. 87.**

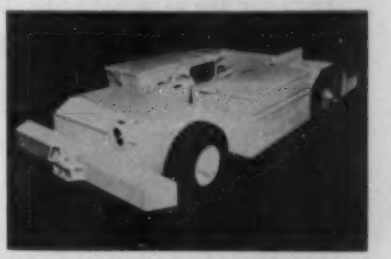


Loading Pocket

Automatic, 80 cu ft loading pockets have been introduced by *Vulcan Iron Works Co.* In these pockets, gates are pneumatically operated, the upper gate being guillotine type and the lower hinged to open under ore pressure when the latch arm is raised. Cast liner plates in the delivery chute are formed to eliminate spillage around the skip. The measuring pocket can also be equipped to load by weight rather than volume. **Circle No. 88.**

Mine Tractor

A heavy duty, battery-powered tractor to meet the requirements for mantrip and supply haulage in high capacity trackless coal mines has been introduced by *Long-Airdox Co.* Equipped with four-wheel drive and four-wheel steer, this tractor can



haul heavy loads at speeds from three to six mph. It is particularly adaptable to pulling trains of 5 to 10 trailers loaded with men or supplies. The tractor employes 48 cell, 96-v, 240 amp-hr capacity batteries. Designed for ac current, this unit also has a charger for dc operation. **Circle No. 89.**

Vibrating Screens

A line of fully enclosed models of vibrating screens has been announced by *Deister Machine Co.* Designed for use where ore and coal create troublesome dust problems, enclosures can be furnished on any screen in the Deister line. The screen suspension system features a heavy box-type, H-beam base (integral with the screen) plus enclosed spring and rubber mounts. Enclosure panels, which can easily be removed for accessibility to all working parts, are fabricated of heavy-gauge steel. Hinged top panels are equally easy to remove. **Circle No. 90.**

DATA

FOR MINE AND MILL

(108) CAREERS IN THE MINERAL INDUSTRY: "Opportunities Unlimited", a booklet designed to introduce high school and college students to the various careers available in the extractive industry, may now be obtained from the Society of Mining Engineers of AIME. Describing the various aspects of the industry, from exploration to mineral beneficiation, the booklet also discusses such subjects as secondary and college training, selecting a college, the cost of a college education, and the opportunities awaiting a new graduate in mineral engineering.

(109) COMPONENTS FOR BUCKET ELEVATORS: *Chain Belt Co.* has published a 24-page bulletin (No. 6057P) to supply basic data on components for the Rex Bucket Elevators, such as chains, buckets, sprockets, bearings, and take-ups. The booklet features simplified selection charts and informational aids which allow quick and easy selection of centrifugal and continuous discharge elevator components. The component selections, as outlined in the bulletin, provide a completely interrelated series of balanced units which are engineered for modern bucket elevator operations.

(110) BIN VIBRATORS: An illustrated six-page brochure describing the complete line of Unit (Bin) Vibrators it manufactures has been released by *Eriez Mfg. Co.* Nine models are available, all AC operated, needing no rectifiers and all providing pinpointed vibration for top performance on hoppers, bins, and chutes. Pictures of actual installations show how various models of the noiseless, semi-noiseless, and impact types of vibrators are mounted on bins and chutes. Explanations are given on how to choose the correct unit for specific jobs to be done. Another page contains drawings and explanations of applications of the Eriez Unit Vibrators on various shapes of bins, hoppers, and chutes. Dimensions and specifications are given and a description of the HI-VI control units which may be used in cases when control of vibration is desired is also included.

(111) CABINETROL POWER CENTERS: *General Electric Co.* recently published a 12-page bulletin, GEA-7080 describing "Cabinetrol" centers. The booklet explains and illustrates how this industrial power center is designed to centralize such functions as motor starting and control, power switching, circuit relaying and sequencing, motoring, process instrumentation, and control of lighting and air conditioning.

MINING ACTIVITIES IN ONTARIO: A 120-page report covering the mining activities in Ontario and of the *Department of Mines*, Toronto, Canada, to the end of 1960 has been released for distribution. The report, entitled, "Barometer Rising—1960" deals with all producing mines in the province, and presents a summary of conditions in the various sectors of the mining industry. The booklet, illustrated with maps, graphs, charts and pictures, also reports on the activities of the various branches and offices of the Department of Mines and contains a directory of key personnel. Write direct.

(102) SUMP PUMP MOTORS: Bulletin GEA-6687A, describing its 1/3 hp, 1725 rpm sump pump motors has been published by *General Electric Co.* The bulletin also introduces motor parts for submersible sump pump applications with brief presentation of how manufacturers can increase their contribution and profits by using motor parts. Cutaway drawings with call-outs point up construction features of the motors and a series of photos describe the moisture resistant insulation, rust-resistant shaft, and permanent lubrication features.

(103) ELECTRICAL EQUIPMENT FOR CEMENT INDUSTRY: How improved electrical systems can make cement plants more profitable is discussed in a booklet available from the *Westinghouse Electric Corp.* The 16-page publication discusses services and products offered by Westinghouse to the cement industry. Illustrated with photographs and drawings, the booklet includes sections on electrical distribution apparatus, control centers, motors and drives, maintenance services, and research presently being conducted within the company to provide better services in the cement industry.

(104) PINCH VALVES: Catalog 609, recently published by *Mine & Smelter Supply Co.*, describes the construction features and advantages of the Massco Grigsby pinch valve system. The 14-page booklet includes sleeve service recommendations and specification charts to guide selection of couplings to resist specific inorganic acids, salts, alkalis, etc.; flow line chart; plus specification tables and engineers' drawings for closing mechansim.

(105) PORTABLE MILL: A four-page, illustrated leaflet describing the Ore Bee Mill—a portable crusher, pulverizer, concentrator—has been released by *Shelton-Cheney Mining Co.* This pamphlet includes construction and operation details, and lists features of the various units.

(106) FILTER MEDIA: How to obtain better filtration results through scientific filter media selection is described in bulletin F-2037A from *The Eimco Corp.* The eight-page booklet outlines the steps involved in properly matching filter media with the characteristics of the slurry to be filtered. It also contains descriptions of new synthetic fabric filter media with photomicrograph illustrations of fabric structures, and a series of case histories demonstrating how the scientific selection of filter media has resulted in improved filtration efficiency.

(107) TOURNAPULL: A new, 22-page catalog describing the V-Power B Tournapull has been issued by *LeTourneau-Westinghouse Co.* This bulletin, TP-442, contains many of the operating features of the B 'Pull. Details on engine, transmission, and other components are illustrated with photographs and drawings. Comprehensive charts supplement other illustrations where necessary, to more graphically present the story of this new machine.

(Continued on page 333)

EMBIE JR. says—

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Company _____

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DATA

FOR MINE AND MILL

(Continued from page 330)

(112) MOTORDRIVES: Catalog G-100, an 88-page publication covering the complete line of its Motordrives (¼ through 40 hp), has been issued by *Reliance Electric and Engineering Co.* Data in the catalog include: full rating tables, dimension diagrams and charts for over 100 different assemblies, and higher overhung load and new controls. The Motordrive is a self-contained variable speed drive unit including an a-c motor, variable pitch pulleys, and a gear reduction unit (when specified) in a single compact housing.

(113) pH METERS: Features, applications, and specifications of the Models G and GS pH meters are reported in a descriptive bulletin published by *Beckman Instruments, Inc.* The Model G is designed for routine pH and millivolt determinations, and quality control applications. Its exceptional sensitivity and accuracy make this instrument especially applicable for direct trace concentration analyses of such anions as chloride and fluoride, and for oxidation-reduction potential measurements. Model GS is a modification of the Model G, employing two additional operating controls to provide 20 times greater meter sensitivity and an eight-fold increase in readability.

(114) POWER CENTERS: Bulletin GET-3041 offers detailed application data of grouped power control panels which utilize standard components arranged to customer's specific requirements. The 16-page booklet issued by *General Electric Co.* details complete specifications on squirrel cage, synchronous-motor, wound-rotor-motor and d-c motor combination starters, as well as incoming line breakers, secondary breakers, and feeder circuit breakers. The bulletin provides customer guide form specifications for electrical equipment and details overload relay heater specifications.

(115) MATERIALS HANDLING: *The Automatic Transportation Co.* has compiled an 80-page booklet titled, "Handbook of Cost Cutting Materials Ideas." The handbook contains: the pros and cons on such subjects as narrow versus wide aisles, walkies versus rider-type trucks, specials versus standard trucks, and pallet versus palletless handling; a thesis on how to analyze materials handling in your plant; flow charts; truck battery calculator charts for selecting the correct battery plus several case histories of proven cost-cutting truck applications.

(116) CRANE EXCAVATORS: *Schield Bantam Co.* has released a recently revised 12-page specification bulletin covering the Series 350 Bantam crane excavators. Bulletin No. 350-2 includes diagrams, capacity charts, work ranges, features, and specifications for clamshells, draglines, pile drivers and tampers, back hoes, and shovels.

(117) DISPLACEMENT BLOWERS: A 12-page bulletin (S88-A) describing the operating principles of their line of rotary positive displacement blowers has been released by *Sutorbilt Corp.* Charts and drawings illustrate dimensions of blowers with pipe plates and gear box assembly. Maximum capacity and horsepower ratings for each of the six sizes in the series are also given.

(118) WATER TREATMENT UNIT: The many applications of Reactor-Clarifier treatment units for water and wastes clarification are described in a 24-page bulletin released by *The Eimco Corp.* The principles on which these units operate are described and illustrated in drawings, cut-away views, and photos. Together with complete specifications for each unit, Bulletin SM-1006-R also features drawings showing flow patterns through the reaction and clarification compartments, by means of which coagulation, floculation, recirculation, and clarification are achieved.

(119) ELECTRIC CHAIN HOIST SPECIFICATIONS: *The Hoist Manufacturers Association* has prepared a bulletin entitled, "HMA-400 Standard Specifications for Electric Chain Hoists." These specifications, intended to promote standardization and to establish a basis for economical procedure, apply to standard type industrial service electric chain hoists.

(120) DISPLACEMENT BLOWERS: A summary bulletin explaining the purposes and capacities of each series of rotary positive displacement blowers has been issued by *Sutorbilt Corp.* The booklet offers information on: speed and pressure ratings, gear diameters, overall unit sizes, special features, and direction for connecting to power sources.

(121) PNEUMATIC INTEGRATOR: Bulletin No. 550.20-2, issued by *B-I-F Industries, Inc.*, illustrates the Pneumatic Integrator Model PDWH-T designed to weigh material being transported on a conveyor belt. This unit multiplies belt travel with belt loading to provide direct read-out of the true weight being conveyed over the weighing section. Its major features include: explosion proof construction, high sensitivity, and simple adjustment for zero settings.

(122) TROLLEY CONVEYORS: *Link-Belt Co.* has issued a 58-page booklet (#2730) concerned with two main subjects: what trolley conveyors can do to reduce manufacturing and hauling costs; and how to select the right one for any requirement. Examples of installations from relatively simple jobs to the most complex systems are shown. The booklet also illustrates how trolley conveyors assist in many of the operations required in modern industry, such as washing, finishing, drying, baking, cooling, assembly, testing, and storage.

(123) GAUGING SYSTEMS: A six-page folder (#105-C) describing details of basic systems employing nuclear gauges for controlling specific gravity or density and liquid or interface levels has been released by *The Ohmart Corp.* Fundamental ideas for using gamma radiation are described as well as components required for a complete system. Schematic diagrams visualize installations, and photos show equipment. Methods of zero suppression, use of associated instruments, temperature regulation, safety and calibration, and maintenance are detailed. Uses in the chemical, petrochemical, petroleum, cement, mining, and pipeline industries are indicated.

(124) CUSHION COUPLINGS: Two types of flexible cushion couplings, one for high speed, high torque applications and another for attachment to flywheels of internal combustion engines, are described in a 20-page bulletin (#901) by *Dodge Manufacturing Corp.* Complete engineering data, photographs, dimension drawing, and selection tables describe the couplings which feature a pan-shaped rubber flexing element. These couplings are designed to accommodate angular and parallel shaft misalignment and end float, to absorb vibration, and to cushion shock loads.

(125) TEMPERATURE REGULATOR: *OPW-Jordan* has released Catalog J180-1, an eight-page booklet containing information on the complete line of sliding gate and plate temperature regulators. Designed for use on steam, water, air, oil, gas or chemicals, these units control temperatures from 35°F to 450°F, at pressures up to 250 psig. Self operated temperature regulators, and combination temperature/pressure regulators are illustrated by photos, cut-sections, and line-drawings.

(126) SEISMIC REFRACTION: The *ABEM Company* has issued an eight-page folder dealing with the theory of seismic refraction method for depth-to-bedrock determination and gives a comparison between the results of this method and those of drilling.

SME PREPRINTS AVAILABLE — 1961 Annual Meeting, St. Louis

The following list of papers (from the 1961 St. Louis Annual Meeting) will be available until January 1962. Coupons (blue) received with the 1961 Dues Bills and those distributed at the Annual Meeting will be honored until Dec. 31, 1961. Purchased coupon books (yellow) will be honored at any time. As more preprints become available they will be added to this list and bulleted (•).

Preprints may be obtained (upon presentation of properly filled out coupons) **from Preprints, SME Headquarters, 29 W. 39th St., New York 18, N. Y.** Additional coupon books can be obtained from SME for $5 (book of ten) to members or $10 (book of ten) to nonmembers. Each coupon entitles purchaser to one paper. **Please do not use coupons for papers other than those listed by number.**

COAL (F)

Bowman, E. V., and Hurst, E. J.: *Material Handling Aspects of Fine Coal Cleaning*, **61F68.**

Boyle, J. A., and Conn, O. S.: *Control of Mine Ventilation Utilizing Multiple Main Fans*, **61F49.**

Elliott, M. A.: *Coal Gasification for Production of Synthesis and Pipeline Gas*. **61F61.**

Hamilton, G. M.: *Gasification of Solid Fuels in the Wellmann-Galusha Gas Producer*, **61F8.**

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BOOKS

(Continued from page 320)

Mining Congress held in Budapest from Sept. 12 to 18, 1960. The work is published in German but the papers were contributed by men from countries ranging from Japan to England, Germany and France, as well as the Iron Curtain countries —Hungary, Poland, Czechoslovakia, the USSR, East Germany, and Yugoslavia, with a corresponding range of subject matter.

Exploration for NonFerrous Metals: An Economic Analysis by Lee E. Preston, *Resources for the Future Inc.*, 1775 Massachusetts Ave. N.W., Washington, D.C., 1960, 212 pp., $2.00 —This volume reviews the recent history of exploration in the U.S. and analyzes costs and apparent results of various methods and programs. Its central argument is that the costs and returns involved in nonferrous metals exploration are such as to make successful exploration likely only for very large firms or syndicates. It discusses the results of three programs of minerals exploration sponsored by the Federal Government and outlines the program now in force; investigates the impact of more general public policy measures on metals exploration; and, finally, considers the unresolved problems of theory and policy which remain.

Authigenic Minerals in Sedimentary Rocks by G. I. Teodorovich, *Consultants Bureau Enterprises Inc.*, 227 W. 17th St., New York 11, N. Y., 1961, approx. 225 pp., $22.50—This monograph is translated from the Russian. According to the stated purpose of the author, it is designed to rouse lithologists and geologists into taking an interest in the geochemical environment associated with the formation of authigenic minerals in sedimentary rocks; to encourage work in tracing the sequence of formation of these minerals; and to direct attention to other genetic problems. In addition to dealing fully with questions of the origin of authigenic minerals in sedimentary rocks, this volume provides the reader with a systematic knowledge of the physical and optical properties of such minerals. The simplified chemical reactions indicated in the book make it easier to distinguish similar minerals and also to detect various mineral deposits in the field. Primary chemical minerals and diagenetic minerals of sedimentary rocks are treated at length. Detailed descriptions are given of the carbonate minerals: glauconite and iron chlorites; sedimentary aluminosilicates of the clay group; zeolites, iron and manganese oxides and hydroxides; and calcium and iron phosphates. There is a full discussion of the important role of colloids, both during transfer of material in the surficial parts of the earth's crust and during sedimentation and mineral development in rocks already formed.

Opportunities in Geology and Geological Engineering by Alfred K. Snelgrove, *Vocational Guidance Manuals Inc.*, 212-22 48th Ave., Bayside 64, N.Y., 1960, 86 pp., $1.65—This monograph, prepared to acquaint career-minded youth with the field of geology, is one of a series of guidance books for career planning. The booklet describes the historical background of the profession, the function of the geologist, advantages and drawbacks of a geologic career, and the educational preparation required. Appendices list other career booklets describing the earth sciences, and the colleges and universities in the U.S. and Canada offering undergraduate and graduate degrees in the geosciences.

Alluvial Prospecting and Mining by S. V. Griffith, 2nd Revised Edition, *Pergamon Press*, 122 E. 55th St., New York 22, N. Y., 1960, 245 pp., $7.50— The first edition of this text was written to produce a work on alluvial mining which would include material excluded from similar tests: modern hydraulic formulas for the calculation of water discharge; a detailed treatment of sluicing; and a description of the working alluvial diamond deposits. This edition has much additional material, including a discussion of earth-moving equipment; details of the forward preparation of overburden vital to the working of low-grade deposits; examination of criteria for the selection of equipment; description of the mining of beach sands; and an expansion of the chapter on alluvial diamond mining. The unaltered sections of the book deal with prospecting methods, sampling and valuation, water supply, hydraulic mining, and gravel pumping. • • •

Capital in Manufacturing and Mining by Daniel Creamer et al, *Princeton University Press*, Princeton, N.J., 1960, 244 pp., $7.50—This monograph is part of an investigation of trends in and prospects for capital formation and financing, sponsored by the Life Insurance Assn. of America, and carried out by the National Bureau of Economic Research, New York. Each of the five principal capital-using sectors of the economy was studied—agriculture, manufacturing, and mining, the public utilities, residential real estate, and governments. Each sector summarizes the major trends in real capital formation since about 1870, in financing since 1900, and the factors determining these trends, as well as the significance of these trends for the future. The book contains much organized information for those in the manufacturing and mining industries who are concerned with the relation between capital and output, and between uses and sources of funds. • • •

Cost Comparison of Various Coke Production Methods, *Economic Research Dept., Shallway Corp.*, 533 Shelbourne Ave., Pittsburgh 21, Pa., 1961, 5 pp., $7.50—This research report based on actual 1960 figures gives cost data for the year 1960, from operating cost figures furnished by coal, coke, and steel companies, averaged for the following types of coke oven: vertical slot-type by-product coke oven, horizontal slot-type semi-byproduct (tar and light oil and gas recovery only) coke oven, horizontal slot-type nonrecovery coke oven, and beehive nonrecovery coke oven. It includes summary data for all four types of oven on such

(Continued on page 344)

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MINING engineering REPORTER

New Copper Powder Plant to Bypass Smelting

Direct reduction of low grade copper ore to metal powder without smelting will be employed in a new plant by Marinduque Iron Mines Agents Inc. in the Philippine Islands. An integrated operation, the plant will press the product powder into strip tubing and wire. Patents to the direct reduction process are held by Chemetals Corp. and Sherritt Gordon Mines Ltd. The plant is scheduled to produce 14,000 tons of copper annually beginning in 1964.

Reynolds Cuts Output

Aluminum output at the Troutdale, Ore., plant of Reynolds Metals Co. was reduced about 7 pct in an "adjustment of the company's inventories." Yearly capacity of the four potlines at Troutdale is 91,500 tons.

Christmas Mine Development

Inspiration Consolidated Copper Co. in its annual report cited delays in development of the Christmas mine due to excessive water on the 1600 level in the No. 3 shaft. Additions to pump equipment have normalized development work and the mine is expected to be producing in the first half of 1962.

Sweden to Work New Ore Field

A Swedish ore field with deposits estimmated at more than 300 million tons, the third largest in the country, will be opened by LKAB Mining Co. To be worked as an open pit operation, the deposit is situated in the Svappavaara district of Arctic Sweden, between the present Kiruna and Malmberget fields. It is estimated that more than $20 million will be spent for mining development over the next five years. Initial output is scheduled at 500,000 tons and this will be increased to some 3 million tons by 1967 or 1968.

$2 Million Titanium Facility Planned

Titanium Metals Corp. of America announced plans for expanding its Toronto, Ohio, plant with a $2 million facility for production of seamless and welded-and-redrawn tubing. The output is scheduled to meet heavier demand by such non-military users as chemical processors. TMCA will have the new facility in production early in 1962.

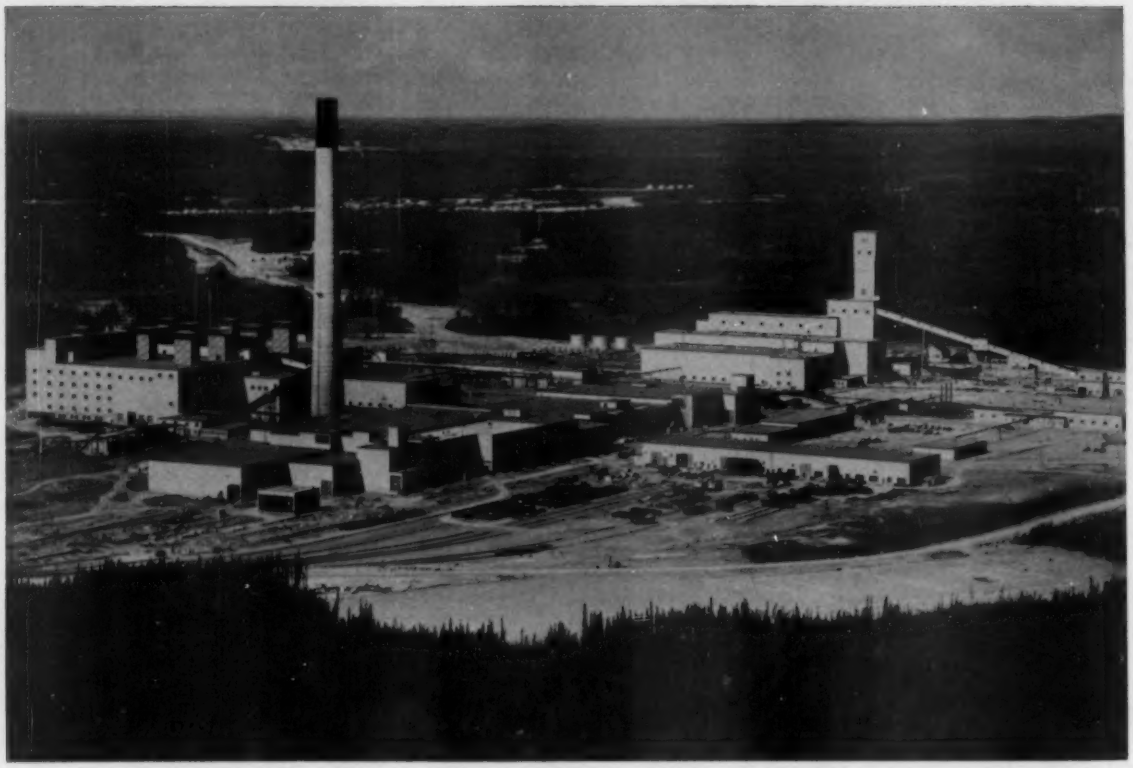
Venezuela Mining Taxes Put On Quarterly Basis

Under new corporate income tax legislation Venezuela now requires its mining and oil industries to submit income tax estimates in the first quarter of the year. Payments based on the estimates then will be made in equal installments following each quarter.

Hearings Held on Lead-Zinc Subsidies

The House Interior Minerals Subcommittee began hearings on a bill to provide subsidies for small lead-zinc mines. The legislation would provide $4.8 million a year to pay individual producers 17¢ a pound for lead and 14.5¢ for zinc for the first 2000 tons of each metal they produce yearly. *(Continued on page 340)*

MINING engineering REPORTER



INCO'S THOMPSON PROJECT DEDICATED

Commercial production begins 51 months after first announcement of development plans.

On March 25, dedication ceremonies were held to signal the start of commercial operations at The International Nickel's Co.'s Thompson project in Manitoba, Canada. Climaxing a ten-year search for a new nickel orebody, the ceremonies marked the beginning of a 75-million lb yearly nickel mining operation that is second only to Inco's operations at Sudbury, Ontario. The world's first fully integrated mining and processing plant, this new operation will raise Inco's total annual production to more than 385 million lb of nickel.

The Thompson deposit, located 22 miles southwest of Moak Lake, was discovered by a magnetometer survey in 1956. The ore is nickel-bearing pentlandite which, with pyrrhotite, occurs as a sedimentary replacement deposit. The ore zone is approximately two miles long and at least 2000-ft deep with widths varying from 6 ft to more than 75 ft. The ore assays 2.8 pct nickel and 0.2 pct copper. Minor quantities of cobalt, platinum, palladium, gold, and silver also are present.

MINE, MILL, SMELTER

Mine: The production shaft at the mine was sunk 2100 ft and a development shaft bottomed at 1057 ft. These two shafts are connected at their 400-ft, 600-ft, 800-ft, and 1000-ft levels. Broken ore, mined mainly by the horizontal cut-and-fill method, is drawn from the stopes to ore cars and hauled to the main ore pass near the production shaft. The ore pass

directs the flow of ore to the primary crusher station located below the 1600-ft level.

After crushing, ore is stored in an underground bin prior to being fed through the shaft loading pocket to skips for hoisting to surface bins in the production shaft headframe. The ore hoist is capable of handling two 15-ton skips in balance at a speed of 2650 fpm.

Mill: The mill, designed to handle approximately 5000 tpd, is presently processing about 2600 tpd, but the full rate of capacity is expected to be achieved shortly. The mill utilizes two stages of crushing, followed by grinding in rod and ball mills which are in closed circuit with hydro-cyclones. The three mills measure 12.5 ft in diameter and 16 ft in length. Following flotation, the nickel concentrate (containing 6 to 7 pct nickel) is pumped to the nearby smelter, while mill wastes are deslimed in hydro-cyclones for use as back-fill in the mine.

Smelter: At the smelter, the nickel concentrate is thickened and filtered. The filtered concentrate is charged into one of three fluid-bed roasters and then carried, with the gas stream from the roasters, to refractory-lined cyclones where the solid particles are settled out and dropped to a furnace-feeding mechanism below. The gases are used to heat the waste-heat boilers and then combined with the gases from the electric furnaces and converters for treatment in a Cottrell precipitator for recovery of dust prior to discharging into 500-ft high concrete stacks.

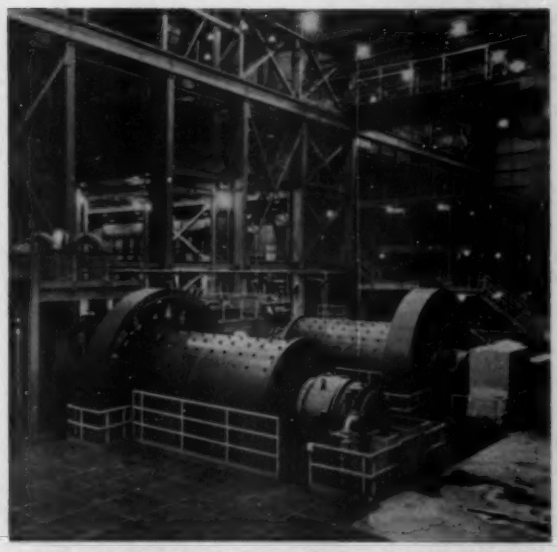
The roasted concentrates are smelted in three 18,000-kva electric furnaces. The furnace matte (17 pct nickel) is transferred to one of four converters where iron content is oxidized and removed as slag. The converter slag is recycled to the electric furnace, granulated, and pumped to discard.

The Bessemer matte is transferred to holding furnaces and cast directly in refinery anodes. After these anodes are cooled, they are dissolved electrolytically in plating tanks to produce 99.9 pct pure cathode nickel. The electrolytic solutions are subsequently treated for removal of impurities and for the recovery of cobalt. Spent oxides, together with any adhering high-sulfur residue are crushed and washed. A filter cake, obtained from the washings, is melted and the sulfur removed, leaving a precious metals residue which is shipped to the Copper Cliff refinery for further processing.

Ore reserves at The Thompson mine are presently estimated at 25 million tons of 3 pct nickel-copper ore.

Inco is continuing its exploration program in the geologic belt containing the Thompson-Mystery-Moak Lake district. The company is presently sinking a 650-ft shaft at Pipe Lake, 20 miles southwest of Thompson, on what appears to be a smaller and lower grade nickel property than that at Thompson.

In addition to the Thompson mine, Inco is in the process of opening two other mines in the Sudbury district. One is an underground operation on the Copper Cliff North property; the other is the Clarabelle open pit operation which is scheduled to be in production in the latter part of this year. The Clarabelle production will replace the declining tonnages from the Frood open pit which is almost worked out.



Interior of the grinding bay at the Thompson mill. The total cost of the Thompson project is approximately $185 million, of which Inco contributed $130 million.

Nickel and copper concentrates are recovered by flotation. The copper concentrates, as well as precious metals residue, are processed at the Copper Cliff refinery.

MINING engineering REPORTER

Producers Slash Zinc Output

Domestic zinc producers announcd a series of production cutbacks. Among the companies paring output were: American Zinc Lead & Smelting Co., 10 pct of slab zinc production or about 1200 tons per month; St. Joseph Lead Co., 15 pct at the Josephtown, Pa., smelter, or about 1650 tons of slab zinc a month and 15 pct of zinc concentrate production at the Edwards and Balmat mines in New York; New Jersey Zinc Co., 15 pct or about 1600 tons of zinc at the Palmerton, Pa., smelter; and American Smelting and Refining Co., 11 pct or about 1100 tons per month at the Corpus Christi, Tex., refinery.

Mattagami Refinery Slated

A $30 million construction project by Mattagami Lake Mines Ltd. will produce the first zinc refinery in eastern Canada. Scheduled for annual capacity of 165,-000 tons, the facility will be built at Valleyfield, south of Montreal, and will work concentrates produced at the new Mattagami Lake mining project some 350 miles northwest of Quebec. The company is controlled by Noranda Mines Ltd., McIntyre Porcupine Mines, and Canadian Exploration Ltd. Mill construction begins this season and with mine investment will cost an estimated $30 million.

Cartel Study Proposal Rejected by White House

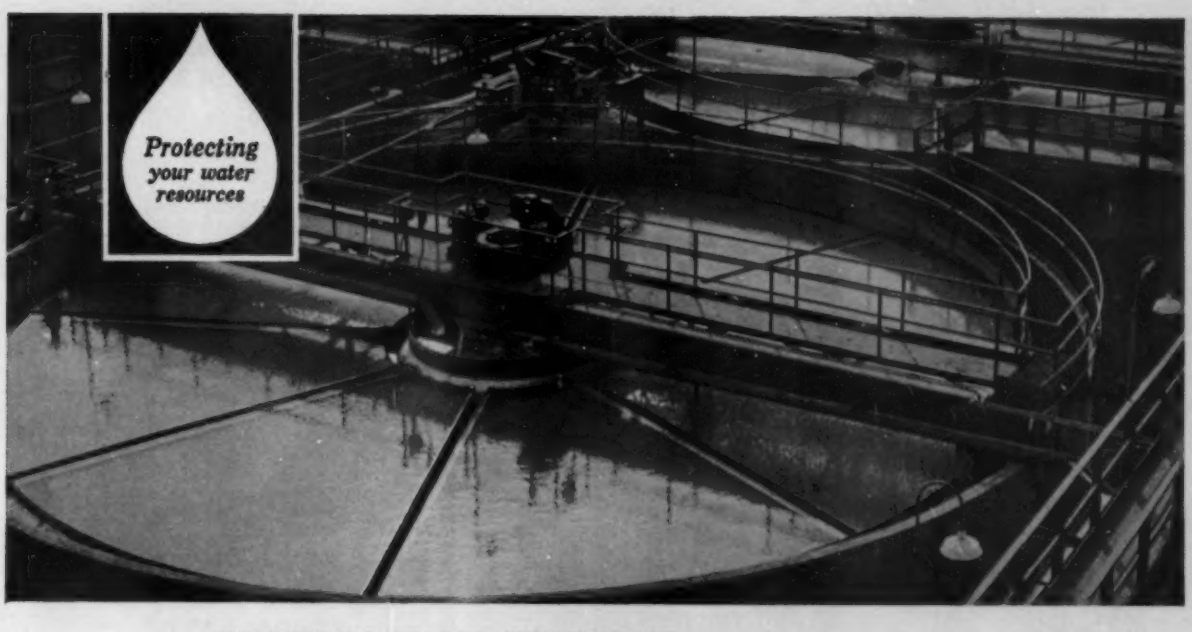
Senator Mike Mansfield's proposal that President Kennedy invite international copper producers for a discussion of production regulations to stabilize prices was turned down by the White House. Senator Mansfield, however, maintained his former position that overproduction had caused price and unemployment problems and that voluntary curtailments would be beneficial. He was referred to a 1958 International copper conference in London by Presidential Assistant L. O'Brien who stated, "It is claimed conditions relative to copper then probably were less favorable than now, but the conference concluded that governmental actions at the international level were not necessary." At the request of the President, however, the State, Interior, and Commerce departments will "reexamine and keep under review the copper situation" and submit their views directly to the Senator.

Consolidation Coal Buys Crucible Mine Through Pittston

The largest coal operation of Crucible Steel Co. of America was sold to Pittston Co., which in turn resold the property to Consolidation Coal Co. The metallurgical coal deposit, at Crucible, Pa., contains estimated reserves of 15 million tons. Consolidation, wishing to increase its high grade reserves, had previously tried unsuccessfully to purchase the property directly from Crucible.

Huge Canadian Mineral Survey Planned

An aeromagnetic survey of the Canadian Shield covering some 1.8 million square miles will begin this summer, according to P. Comtois, minister of mines, in Ottawa. The survey is expected to take some twelve years to complete and will cost an estimated $18 million. Some two thirds of the expenditure will be divided between federal and provincial governments and the balance will be paid by the federal government in the Northwest Territories and the Yukon. Commercial firms will make the surveys and evaluate results.



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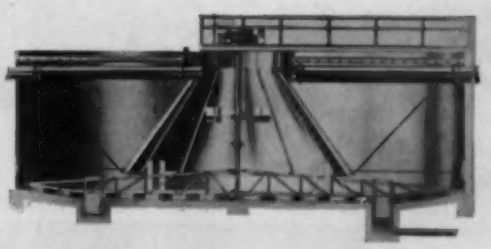
So that you may have all the facts about modern Reactor-Clarifiers in a convenient reference, we've prepared a new 24-page bulletin containing much valuable information. Get your copy of Bulletin SM-1006 from the Eimco-Process representative in your area. Or, write Eimco's Process Engineers Division.

******for example*

The Type HRB high rate solids-contact Reactor-Clarifier is a type highly effective for conditioning water from surface sources for process use.

High volume recirculation is achieved in a turbine reactor engineered to set up a flow pattern that results in repeated recirculation in the conical-shaped reaction compartment before the water enters a separate clarification compartment. The unique movement created by this mixing assures complete utilization of coagulating chemicals and less water in the withdrawn sludge. Variable speed operation gives this type Reactor-Clarifier exceptional sensitivity to varying influent characteristics.



Reactor-Clarifier is a trademark of The Eimco Corporation.

THE EIMCO CORPORATION
Salt Lake City, Utah

B-708

Process Engineers Division
420 Peninsular Avenue, San Mateo, Calif.

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BOOKS

(Continued from page 335)

cost factors as capital cost, capacity and operating cycle, coke yield, space requirement, operating labor requirement, operating labor cost, and byproduct values.

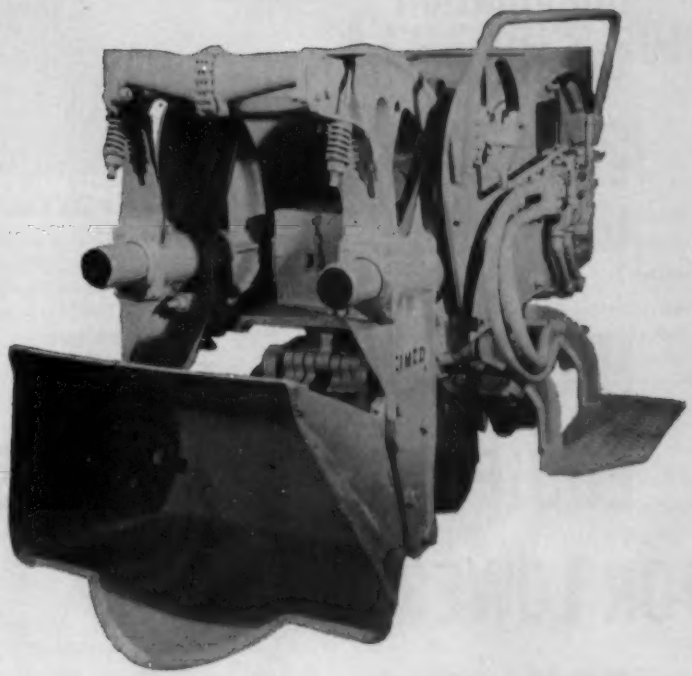
Cobalt: Its Chemistry, Metallurgy, and Uses edited by Roland S. Young, *Reinhold Publishing Corp.*, 1960, 424 pp., $15.00—Designated as A.C.S. Monograph No. 149, this work replaces Monograph No. 108, Cobalt, written by Mr. Young who, as editor of this new monograph, contributes sections dealing with the history, occurrences, extractive metallurgy, chemical and physical properties, compounds, metallurgical applications, and biology and biochemistry of cobalt. Other sections, also written by specialists, summarize the newer developments in cobalt technology, and discuss such topics as coordination compounds; phase diagrams; magnetic, electrical, and electronic applications; radioactive cobalt; and cobalt alloys in high-temperature, high-strength service. • • •

Concrete Engineering Handbook by William S. Lalonde, Jr., *McGraw-Hill Book Co.*, 1961, various pagings, $25.00—A collection of fundamental and practical design and construction information compiled by 20 specialists, who assume prior knowledge of structural mechanics and of reinforced concrete in preparing their contributions. The wide coverage includes design methods for various types of structures, special resumes on structural theory, torsion, materials, and construction methods, as well as techniques for the design of chimneys, storage bins, pavements, bridges, and skin structure. Special topics such as applications of pre-stressed concrete and the handling of building-frame deflections caused by earthquake forces are considered. Also included are such design aids as diagrams, and tables enabling rapid selection of concrete slabs, beams and footings in building design, given loads, shears, and choice of fiber stresses. • • •

Texas Fossils by William H. Matthews III, Guidebook 2, Bureau of Economic Geology, *The University of Texas*, Austin 12, Texas, 1960, 123 pp., $1.00—As a guide for amateur fossil collectors, the author systematically discusses the more important fossils found in Texas, including plants, invertebrates, and vertebrates. Profusely illustrated and written with a minimum of highly technical terms, the booklet contains a short resume of the physiography and geology of the state, a bibliography, glossary, and index.

(Continued on page 347)

GET NEW EIMCO® 24 MUCKING CAPACITY...



OUTPRODUCES ANY OTHER LOADER ITS SIZE!

The new Eimco 24 RockerShovel® loader can muck out 60 cubic feet in just one minute. That's more than any other loader its size, and appreciably more than its predecessor the Eimco 21 RockerShovel, the standard of performance around the world. New design features have increased the mucking capacity... and lowered maintenance costs.

MUCK OUT MORE WITHOUT INCREASING AIR PRESSURE. The 24's rocker arms are re-designed to give greater lifting capacity. The cycle time is the same but the bucket is larger.

DIG IN FOR BIGGER BUCKET LOADS. The 24 can dig with greater force because patented, involute rail thrust ends give sturdy support to the rocker arms during crowding. You get solid positive thrust support, unlike other machines where nothing more than cables hold the arms in place.

LOAD LARGER AND LONGER CARS. New rocker arms give longer throw . . . increased range of discharge heights. What's more, patented, enclosed spring bumpers give maximum machine stability at discharge—and spring life too.

CUT SERVICE TIME AND COSTS. Now you can replace the rocker arm rails, easily and inexpensively. Heavy duty anti-friction bearings are used throughout. The 24 is built with the best, high strength steels and put together to last . . . with world-famous Eimco craftsmanship.

The Eimco 24 is bound to set new production records in the mining industry, and it can in your operation too! See for yourself. Contact your Eimco dealer, representative or write to The Eimco Corporation, P. O. Box 300, Salt Lake City 10, Utah for Bulletin L-1140A.

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BOOKS

(Continued from page 344)

STATE PUBLICATIONS

Alabama

Alabama State Mine Experiment Station
School of Mines
University of Alabama
University, Alabama

Coal Reserve Estimates on a Regional Basis, Contribution No. 8, 1960, 1 copy gratis, additional copies 25¢.

Arizona

Arizona Bureau of Mines
The University of Arizona
Tucson, Ariz.

Geologic Map of Pima-Santa Cruz County, 75¢, 1960. **Some Rare-Earth Mineral Deposits in Mohave County, Arizona,** Bull. 167, 1960, 50¢, free to Arizona residents.

Colorado

Colorado School of Mines
Golden, Colo.

Paleozoic Solenoporaceae and Related Red Algae, Quarterly of the Colorado School of Mines, Vol. 55, No. 3, 1960, $1.25.

Georgia

Department of Mines, Mining, and Geology
19 Hunter Street, S.W.
Agricultural Bldg.
Atlanta 3, Ga.

Publication of the Geology and Mineral Resources of Georgia, 1959 (6th edition), Circ. 1., 1959, gratis.

Idaho

Bureau of Mines and Geology
Moscow, Idaho

Placer Deposits of the Elk City Region, Pamphlet 121, 1960, $1.00.
Study of Two Idaho Thorite Deposits, Pamphlet 122, 1960, $1.25.

Illinois

State Geological Survey
Natural Resources Bldg.
Urbana, Ill.

Pennsylvanian Plant Fossils of Illinois, Educational Series 6, 1960, 25¢.
Fluid Flow in Petroleum Reservoirs. III—Effect of Fluid-Fluid Interfacial Boundary Condition, Circ. 291, 1960, gratis.
Glacial-Drift Gas in Illinois, Circ. 292, 1960, gratis.
Clay Mineralogy of Pre-Pennsylvanian Sandstones and Shales of the Illinois Basin. Part III—Clay Minerals of Various Facies of Some Chester Formations, Circ. 293, 1960, gratis.
Sand and Gravel Resources of Champaign County, Illinois, Circ. 294, 1960, gratis.
Gumbotil, Accretion-gley, and the Weathering Profile, Circ. 295, 1960.
Illinois Fluorspar, Circ. 296, 1960 gratis.
Geochemistry of Carbonate Sediments and Sedimentary Carbonate Rocks. Part I—Carbonate Mineralogy, Carbonate Sediments, Circ. 297, 1960, gratis.
Geochemistry of Carbonate Sediments and Sedimentary Carbonate Rocks. Part II—Sedimentary Carbonate Rocks, Circ. 298, 1960, gratis.
Geochemistry of Carbonate Sediments and Sedimentary Carbonate Rocks. Part III—Minor Element Distribution, Circ. 301, 1960, gratis.
Geochemistry of Carbonate Sediments and Sedimentary Carbonate Rocks Part IV-A—Isotopic Composition Chemical Analyses, Circ. 308, 1960, gratis.
Geochemistry of Carbonate Sediments and Sedimentary Carbonate Rocks. Parts IV-B—Bibliography, Circ. 309, 1960, gratis.
Sand and Gravel Resources of Kane County, Illinois, Circ. 299, 1960, gratis.
Mineral Production in Illinois in 1959, Circ. 300, 1960, gratis.
Lower Pennsylvanian Clay Resources of Knox County, Illinois, Circ. 302, 1960, gratis.
Ceramic Tests of Illinois Clays and Shales, Circ. 303, 1960, gratis.

Indiana

Publications Section
Geological Survey
Indiana University
Bloomington, Ind.

Geology and Coal Deposits of the Coal City Quadrangle, Greene, Clay, and Owen Counties, Indiana, U.S. Geological Survey Coal Investigations Map No. C 20, 1959, $1.00 plus 10¢ mailing charge.
Geology and Coal Deposits of the Switz City Quadrangle, Greene County, Indiana, U.S. Geological Survey Coal Investigations Map No. C 41, 1960, $1.00 plus 10¢ mailing charge.

ABSTRACTS

In This Issue: *The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.*

The Significance of Mineralized Breccia Pipes by *Vincent D. Perry*—The author describes world occurrences of breccia pipes with special emphasis on the relationship to Cananea pipe mineralization deposits. Geologic interpretations of mechanization of emplacement are cited. Diagrams of the sequence of formation of La Colorada ore pipe are included. **Ref.** (MINING ENGINEERING, **April 1961). p. 367.**

Underground Use of Ammonium Nitrate-Fuel Oil Explosives by *John L. Ryon*—Underground application of AN-fuel oil mixture as a blasting agent at the Avery Island, Detroit, and Retsof mines of The International Salt Co. is described. Initial experiments were conducted at Detroit, where several thousand drillholes were loaded with AN-fuel oil mixture in the course of two and a half years. The author outlines International's experimental activities with these explosives, describes present AN loading and blasting procedures, and covers the proposed use of this material at the Company's Cleveland mine, which is going into production. **Ref.** (MINING ENGINEERING, **April 1961) p. 377.**

Determination of Power Consumption of Grinding-Mills in Cement Plants by *Ross W. Smith*—The author illustrates methods by which it becomes possible to calculate actual horsepower used by the various mills and to compare as calculated by several different methods. Bond grindability as well as Hardgrove grindability test data is used in the computations. The author indicates that the bond grindability analyses can be used with confidence as practical tools in determining power consumption of grinding-mills in cement plants. **Ref.** (MINING ENGINEERING, **April 1961, p. 381.**

Use of Data Processing Machines For Calculating Ore Reserves at the Sullivan Mine by *A. C. Freeze*—An electrical data-processing system using punch cards has been developed by the Geological and Accounting Depts. at the Sullivan mine of The Consolidated Mining and Smelting Co. of Canada Ltd. as an important aid in calculating ore reserves. The article outlines the mining situation for which the procedures were developed and describes briefly the equipment used and the essential steps followed in computing reserves. **Ref.** (MINING ENGINEERING, **April 1961) p. 384.**

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. . . KW-DART engineers planned the KW-DART 50 EDT with your operation in mind, and it is tailor-made to provide maximum performance . . . minimum maintenance . . . maximum payload. It is designed to *reduce* your hauling costs . . . it's *rugged* and *right* for the job.

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Why I continue to believe in the personal approach to engineering for the mining industry

Success in the design and engineering of mining installations still is a matter of attention to specific requirement; care to details—and goals. Thus, today, despite the tendency toward the grand scale in engineering services (certainly necessary and, indeed, essential for many types of projects), I continue to endorse the soundness of personal service to my clients.

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Many independent engineers continue to devote their careers to the "tailored" development of a limited number of mine and mill projects each year. Their success for clients in this effort supports my belief: that *personal* capability, *personal* attention to individual problems of each job, and *personal* supervision throughout the job pay long-lasting dividends.

My interest in the success of *your* project will continue far beyond the completion of facilities.

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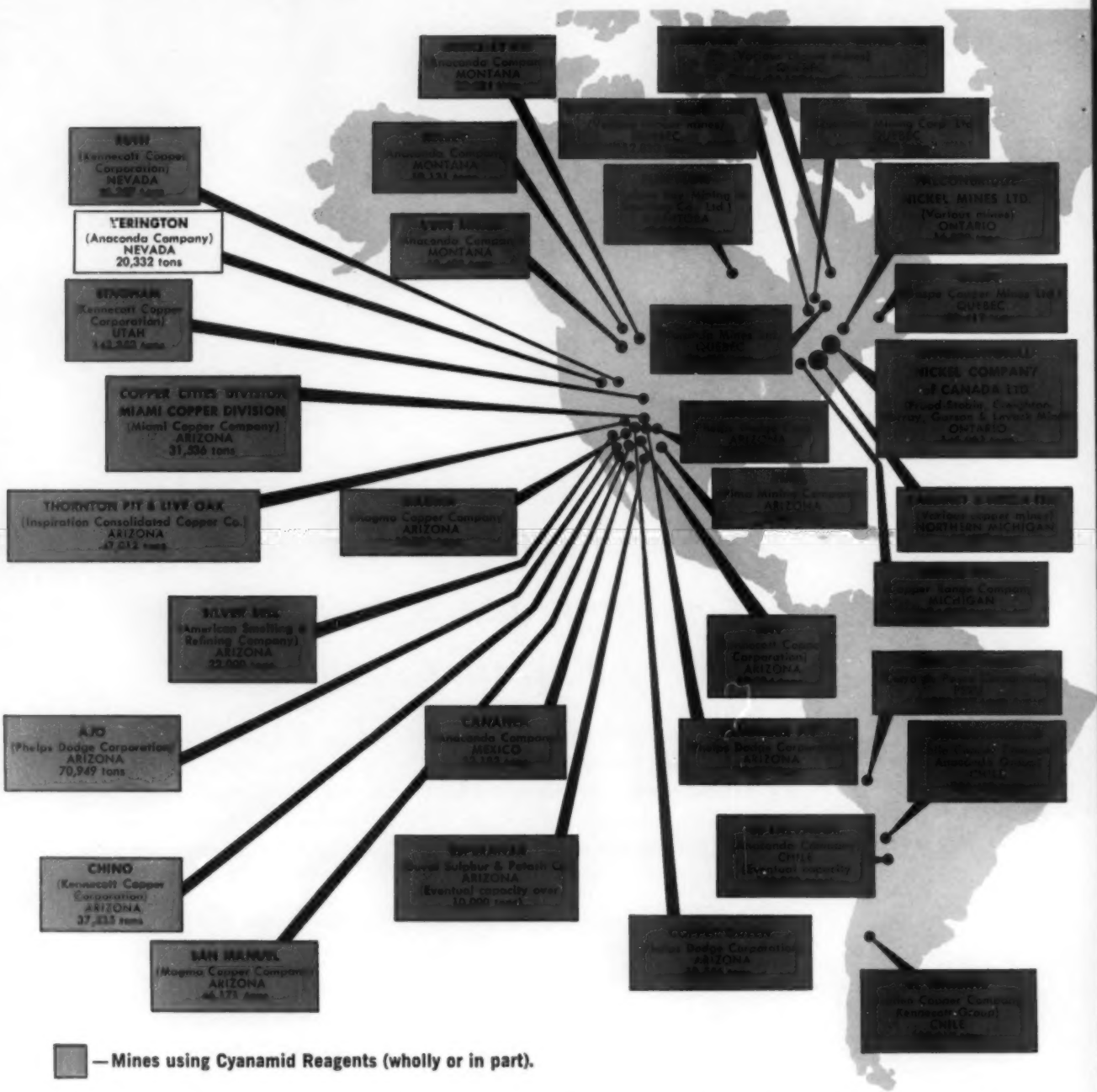
Where there's Copper...



— Mines using Cyanamid Reagents (wholly or in part).

As the map so clearly indicates, Cyanamid supplies part or all of the reagent requirements for virtually every major copper mining property in the world.

This is true for other ores, too, and the reasons can be summarized in one sentence! Cyanamid offers every mining district dependable delivery of the broadest range of metallurgical chemicals available from a single source plus in-the-mill assistance in their use.

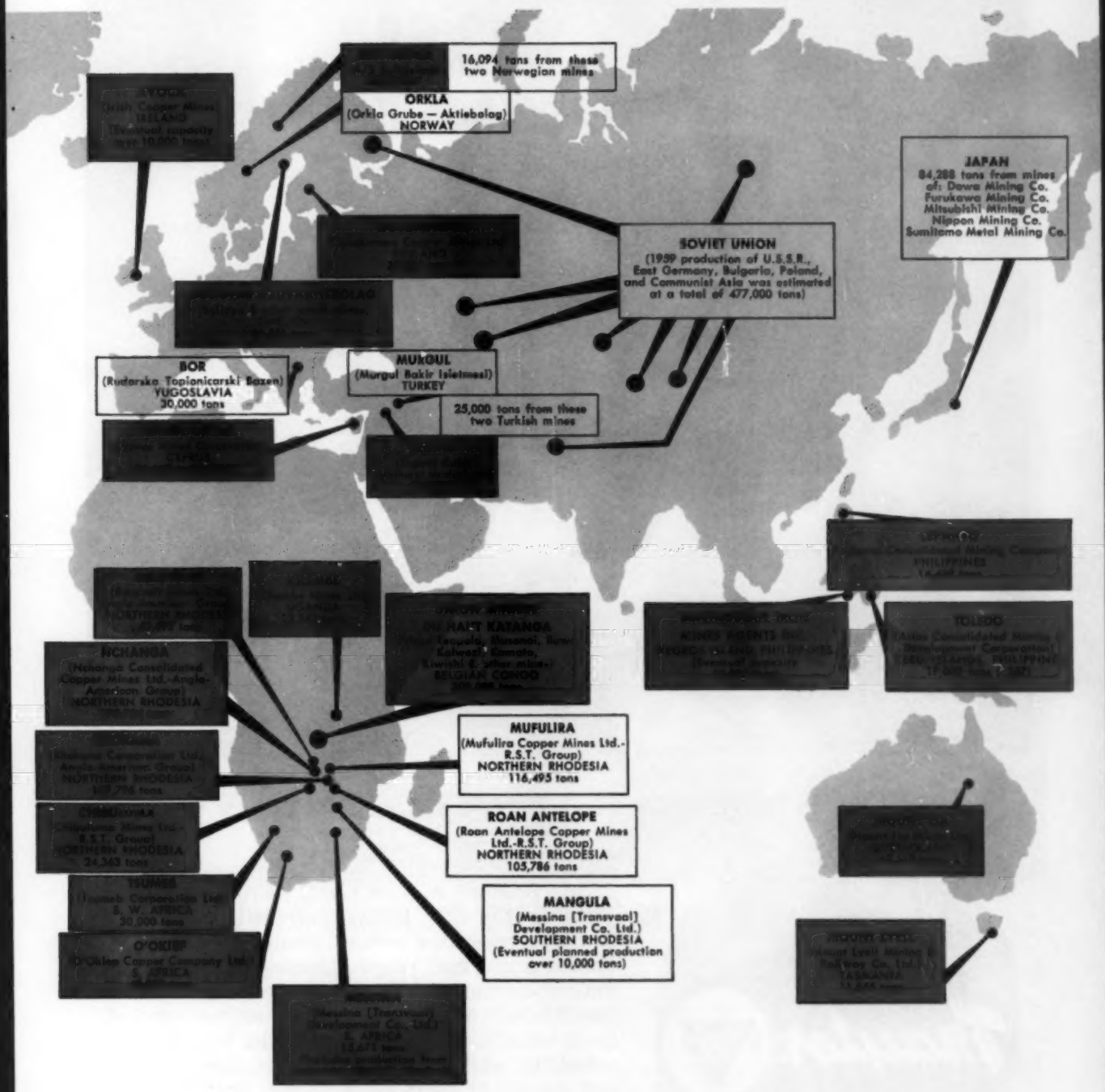
No matter what ore you're treating, a Cyanamid Field Engineer stands ready to help you improve recovery and cut costs by suggesting more efficient reagent combinations. His recommendations are based on a thorough knowledge of up-to-the-minute ore dressing technology around the world.

For prompt assistance on your reagent requirements, get in touch with our nearest office.

1959 mine production of copper metal in short tons (unless otherwise noted)

SOURCES: Company Annual Reports, Year Book of the American Bureau of Metal Statistics, Copper Institute
Year Book of the British Bureau of Metal Statistics, Metallgesellschaft Aktiengesellschaft Metal Statistics

there's a *Cyanamid* Reagent!



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EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL — *Mining Chemicals Department*
Cable Address: — Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

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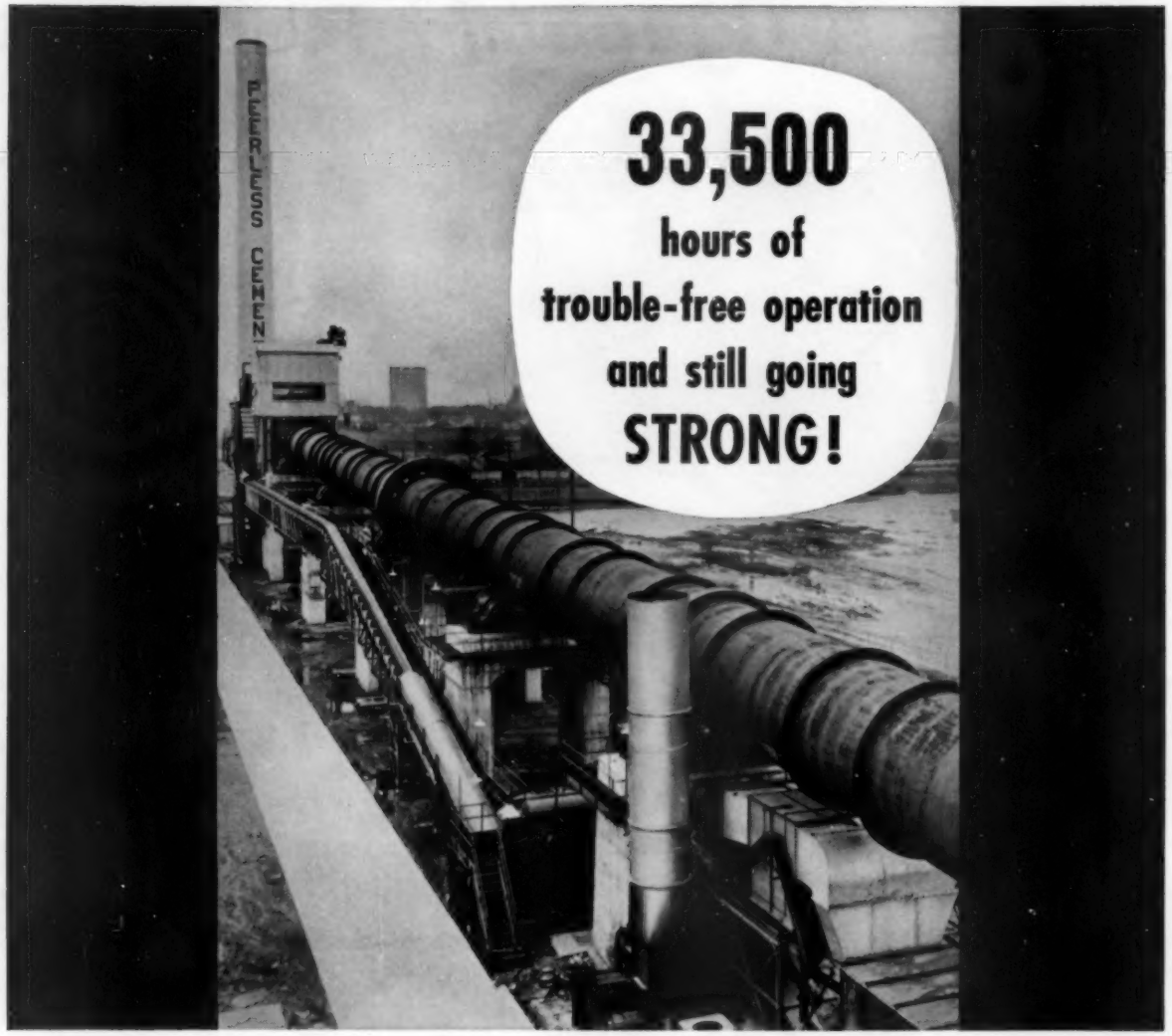

Typical performance of a **TRAYLOR** rotary kiln

Installed in 1956 at the Peerless Cement Company's Brennan Avenue plant, Detroit, Michigan, this 11'6" x 425' kiln has averaged 23 hours of operation a day without costly downtime. Traylor engineers, intimately acquainted with the problems and needs of the cement industry, painstakingly research and design each kiln to do its specific job. That's why Traylor kilns are noted the world over for minimum downtime and maximum years of profitable operation.

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"See Chemical Engineering Catalog for further details and specifications."

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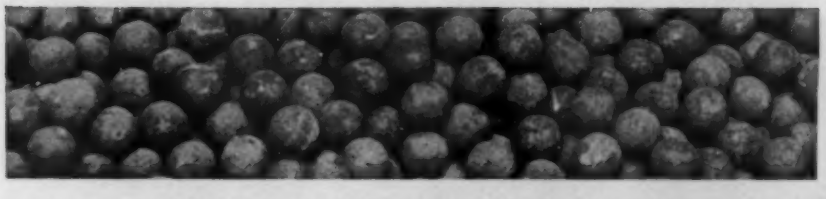

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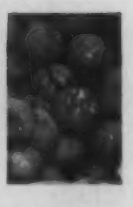
Economical
Efficient
Lasting

Steel



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Around the world, over a million tons of Sheffield Grinding Balls have given customers the top efficiency that comes from consistently uniform hardness, toughness and fine, dense grain structure right to the core. This uniform grinding efficiency (which also means uniform economy) is the result of Sheffield's constant quality control in alloying, forging and heat-treating — from furnace to finished ball. **Sheffield Plants: Houston, Kansas City, Tulsa.**

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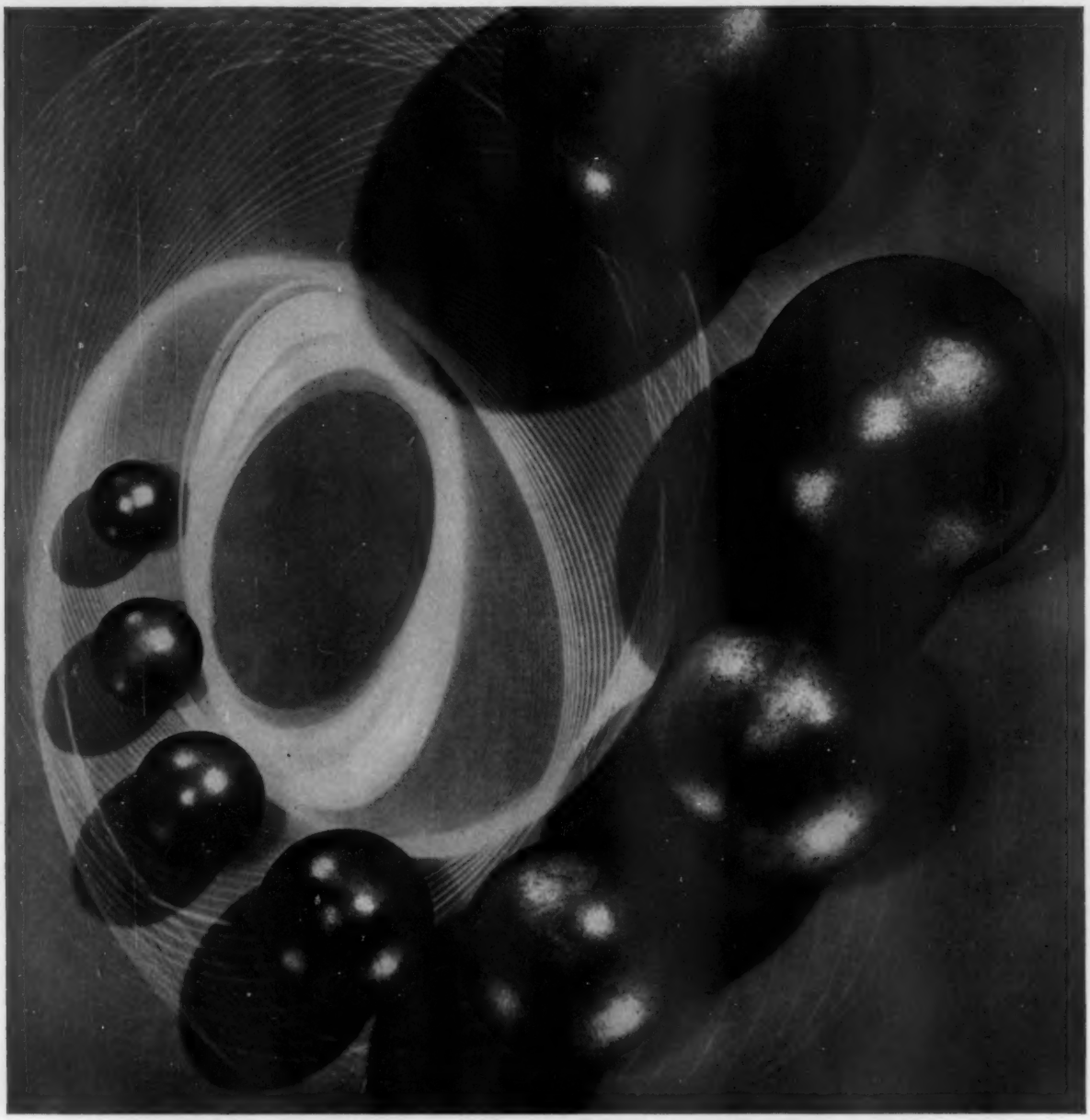

CF&I controls grinding ball quality all the way

As an integrated manufacturer, CF&I has an opportunity to exercise careful quality control at every stage of grinding ball manufacture, from the mine to the finished product.

The result is forged alloy and carbon steel balls that have outstanding hardness (resistance to wear), toughness (resistance to impact splitting), uniformity of roundness and uniform density. These uniform physical properties mean better milling results for you—the user.

CF&I Grinding Balls are available in the following range of sizes: Forged Alloy Steel Balls—1½″ to 4″ in diameter; Forged Carbon Steel Balls—¾″ to 5″ in diameter.

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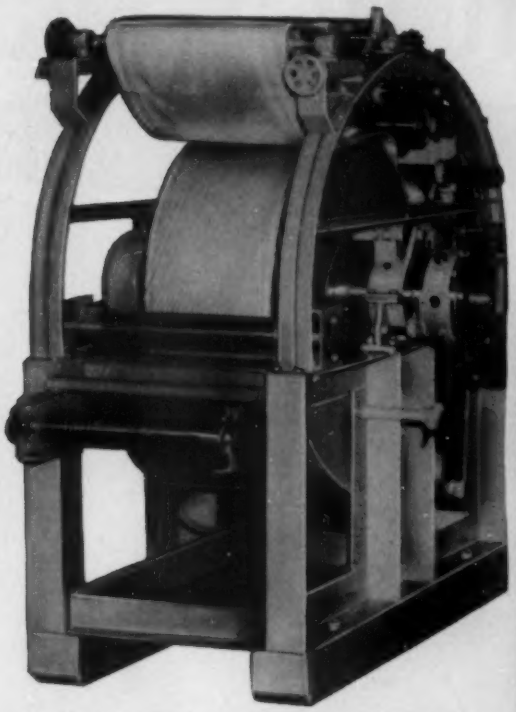
Which pilot plant filter do you need?



DRUM FILTER — String, scraper, roller, belt and precoat discharge can be tested on the extremely flexible FEinc Pilot Plant Drum Filter. Submergence washing and compression dewatering mechanism can be utilized if desirable. The 3 x 1 ft. size has 9.4 sq. ft. of filtering area and is constructed of Type 316 stainless steel. Smaller sizes available.

Eliminate the risk and unnecessary capital investment by scaling up from one of the seven Pilot Plant Filters offered by FEinc.

Available on a rental basis, these units allow you to determine optimum design and operation conditions for maximum filtering efficiency in your particular process. See our insert in Chemical Engineering Catalog, or write for bulletins or technical advice without obligation. Address Dept. MEF-461.

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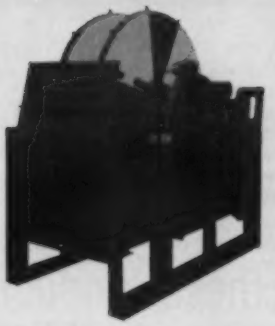

DISC FILTER — FEinc Disc Filters for pilot plant work are also available. All FEinc pilot models are supplied with the filter cloth determined best for the application.

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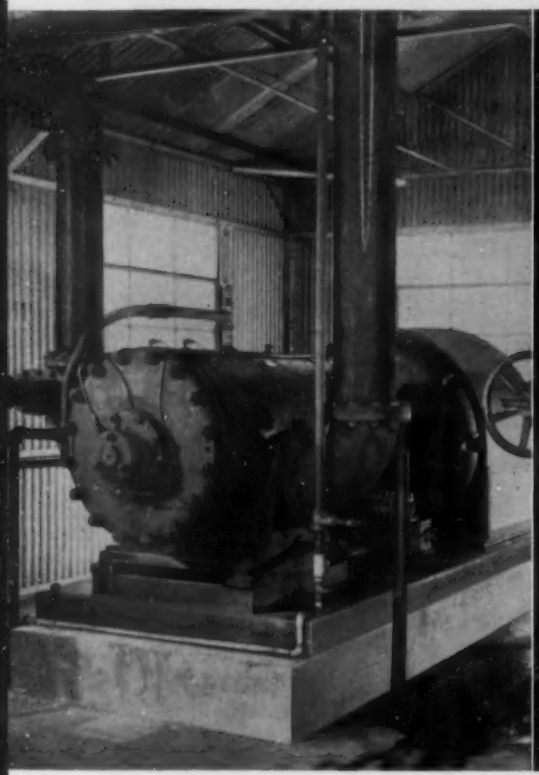
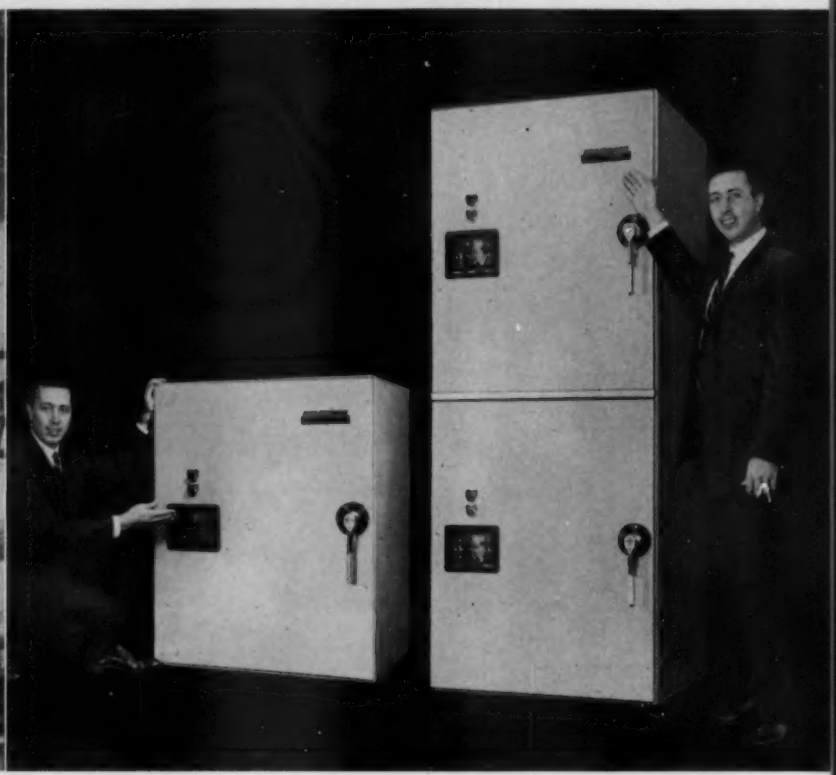
ideas and news:



Constant vacuum . . . year after year: Ro-Flo vacuum pumps with sliding-vane rotary design eliminate operating losses inherent in reciprocating machines. Centrifugal force keeps vanes in close contact with cylinder walls, automatically compensating for wear. In addition, few moving parts required, reduce wear, simplify maintenance.



So low, two fit where one used to go: This new SpaceMaker control center is the first completely new 2- to 5-kv motor controller development in more than a decade. New compact two-high design can cut floor space requirements in half. Complete drawout construction makes it the safest, most easily accessible controller on the market. New flame-retardent, track-resistant Super Pyro-Shield insulation adds to reliability, reduces size and weight. And, the all-new roll-out contactor has been designed specifically to cut maintenance time and costs.

Which of these productive ideas could be working for you?

A system that makes low-grade ore valuable. New motor controls that save space. Where could your company apply these? What about all the rest of the idea-filled products which result from the A-C "usefulness" concept of design? Have an application? Call your A-C representative for information. Or write Allis-Chalmers, Industrial Equipment Division, 906 S. 70th St., Milwaukee 1, Wis.

Ro-Flo, Grate-Kiln, Superior, Hydroset, SpaceMaker and Pyro-Shield are Allis-Chalmers trademarks. A-1403

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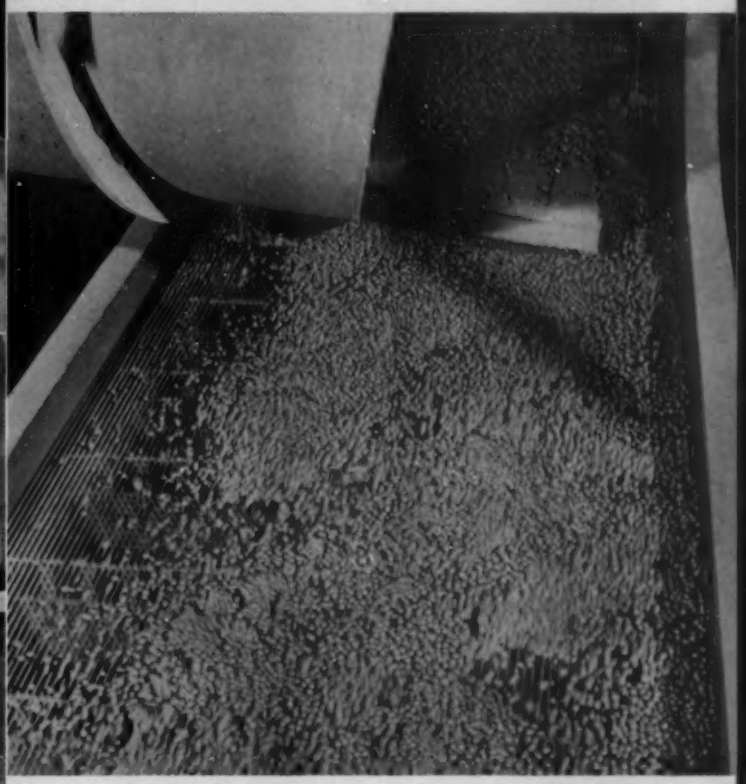
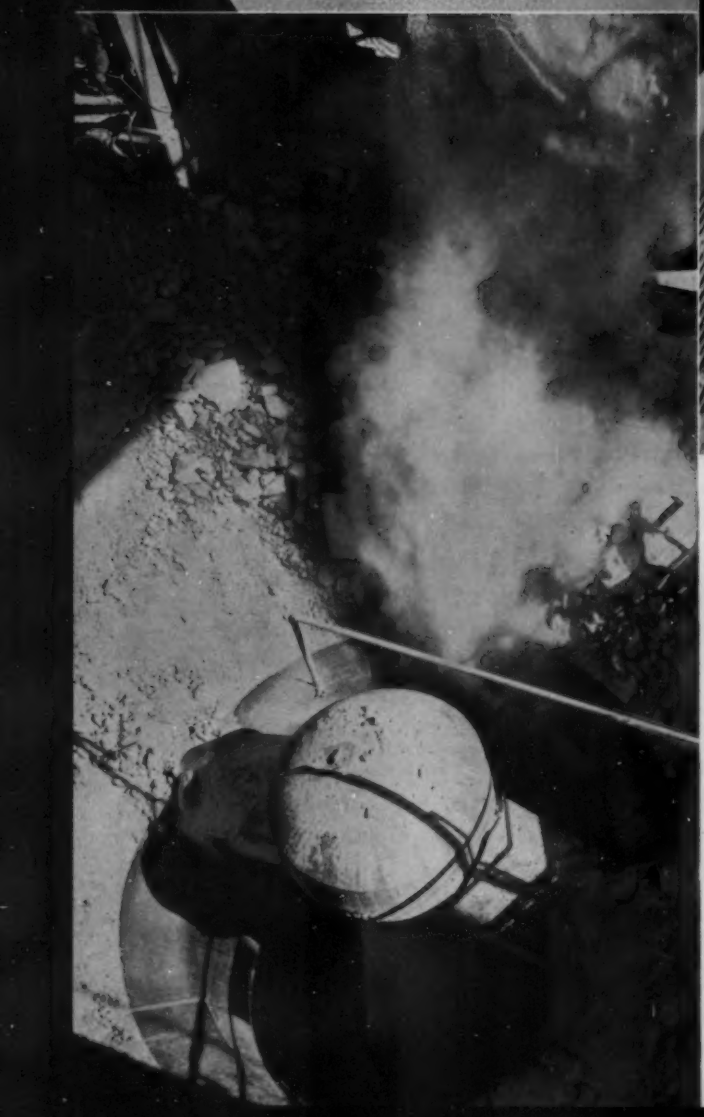
From low-grade ore . . . ideal blast furnace feed: Now processing 1000 ltpd of beneficiated, finely powdered concentrates from low-grade iron ore, the new Grate-Kiln system produces these iron-rich pellets. Easy to ship and ready to use as blast furnace charge, these pellets are also economically produced. Costs are kept low by a unique system of heat recovery and process control.

Keeping pellets optimum sized: Installed as part of the first Grate-Kiln system used for iron ore processing, this specially-designed A-C vibrating screen "sizes" pellets from the Allis-Chalmers balling drum, permits only properly sized balls to pass to the system for heat processing. Years of experience in handling screening problems like this have resulted in a wide range of screen sizes and features.





Rugged primary gyratory crusher: This 60-inch Superior gyratory crusher crushes tons of hard, abrasive ores daily — proof of its tough construction. But, in addition, this machine requires no downtime for resetting to compensate for mantle and concave wear. The Hydroset control, exclusive with A-C cone and gyratory crushers, permits instantaneous wear — compensating adjustment while in operation.

A-C INDUSTRIAL EQUIPMENT DIVISION: motors, generators, controls, rectifiers, pumps, compressors, crushers, mills, screens, kilns, coolers, industrial systems.

OTHER A-C PRODUCTS: thermal, hydro and atomic electrical generating equipment; switchgear, transformers, unit substations; tractors, earth-moving equipment, engines, lift trucks.

ALLIS-CHALMERS

Jeffrey repeat orders prove conveyor production performance

Almost unbelievable performance is demanded of most mine equipment, and belt conveyors are no exception. These are required to function under most adverse conditions. Few can take the punishment long enough to win the approval of alert, progressive mine operators. Jeffrey wire-rope type conveyors can. Proof of that easily can be seen in repeat orders placed by leading coal producers. The Clinchfield Coal Company, Dante, Virginia, is one of these. Ten miles of Jeffrey wire-rope type belt conveyors have been purchased for their Moss #3 Mine.

Year	Units	Total Feet
'58	6	8,000
'59	4	9,500
'60	4	13,000
'61	8	22,500

These belt conveyors are about equally divided between 36-inch and 48-inch widths.

Jeffrey wire-rope type conveyors last longer because the wire rope provides a spring-like action to cushion the loaded belt as it rides over the idlers. Permaseal* Idlers are sealed to keep out dust and dirt...give years of maintenance-free operation.

For complete information about Jeffrey wire-rope type conveyors, write for Catalog 970. The Jeffrey Manufacturing Company, 865 North Fourth Street, Columbus 16, Ohio.

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MINING engineering **DRIFT**

PREPRINTS TO PEOPLE-TO-PEOPLE

A question asked recently by a member of SME was, "What happened to the unused 1960 preprints which were no longer available after January 1, 1961?" This question is posed particularly by those members who requested 1960 papers after the deadline, only to find that their orders could not be filled (except as photostats from the Engineering Societies Library).

The necessity of disposing of the previous year's preprints is prompted by the lack of adequate storing and filing facilities, coupled by the ever-increasing number of the current year's preprints. Although the cost of the *entire* 1960 preprint program was only 12½¢ per member, the unused copies did represent a small investment and, as such, it was felt that *after* SME members have had a reasonable length of time to procure their own copies, the remaining papers should be put to the best use possible—rather than just being filed in the waste basket.

A sensible solution to this problem has been found—the People-to-People Program. Although it is basically a Presidential Committee in which both former President Eisenhower and President Kennedy are actively interested, the Program is not an official government undertaking. Mr. Howard S. Strouth, a member of SME and actively engaged in "PTP," recently wrote:

> "The committees are composed predominately of senior personnel of large corporations, universities, and retired gentlemen with similar background and heavy experience in the foreign field. They dedicate their time, money, and efforts without remuneration.
>
> Basically, it is felt that a number of under-developed areas suffer from lack of contact with us, lack of technical know-how, lack of feeling that a link exists between engineers, scientists and others in the United States and their own country, and finally, lack of funds for up-to-date publications, lab equipment and other basic means.
>
> The members of the Committees of PTP have tried to alleviate these lacks by contributing advice (either directly or in the form of lectures in foreign universities), contributions of scholarships, books, technical publications, lab equipment, sponsorship of specific programs, etc."

To help answer this need for technical material, SME donated all unused copies of 1960 preprints to the People-to-People Program. Members of "PTP" distributed these papers to mining schools around the world, *based on each country's need for such material*. This year, 80 pct of the papers went to Latin America, where text books and most other technical material related to mining (and other engineering disciplines) is in very short supply. The remaining 20 pct of the preprints were sent to mining engineering schools in such countries as Turkey, India, etc.

"PTP's" basic philosophy is that the stimulation of friendship between *individuals* of the U.S. and foreign lands, by employing the bond of mutual professional interest as a catalyst, has a more beneficial effect than the difficult, and often futile, attempt to unite heterogenous *masses* of people. By developing closer relations between the members of two nations, it becomes possible to effect better relations between the nations themselves.

This program makes sense. It also prevents the needless waste of destroying unused preprints. Nobody can foretell whether or not "PTP" will prove as effective as one may hope, but it does serve as an excellent and worth-while vehicle to disseminate up-to-date information contained in SME preprints to friends and potential friends overseas *while* it can do the most good.

All this, of course, only after SME members have had ample time to acquire the preprints they need. *Paul C. Merritt.*

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The LRD-3 is available with either crawler or truck mounting. An enclosed cab can be furnished to provide all-weather protection for the operator while drilling. All controls are conveniently grouped for easy operation and good visibility.

The traveling head design of the LRD-3 provides positive mechanical power without excessive torque loss under heavy pulldown, and permits easy control in making up and breaking down drill pipe. Every function of the unit is designed to speed productive drilling and keep the operator making hole. Leveling, raising the mast, and even the automatic drill pipe magazine are hydraulically controlled for speedy operation. A powerful dust collector traps cuttings and blows them well away from the unit.

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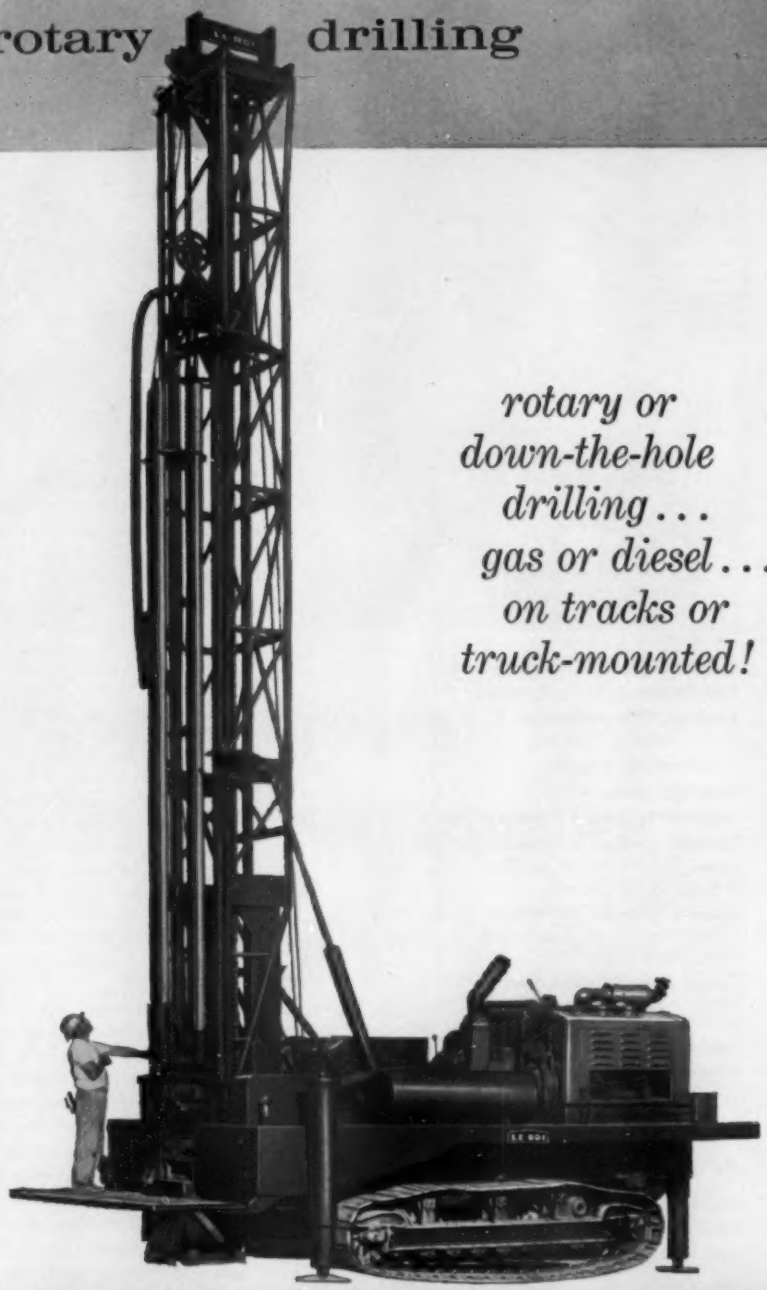
The LRD-3 comes complete with a hydraulically operated magazine with capacity for four 20 ft. drill pipes, and can be equipped with such optional equipment as lights for night-time operation, a mounted bit grinder, air hoist, breakout tongs, water injection system, etc. Specification Sheet AT-147 describes the unit in detail, with complete spec information. Send for a copy.



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THE PRESIDENTIAL ADDRESS

STATE OF THE INSTITUTE

by JOSEPH L. GILLSON
President of AIME, 1960

In this past year of our Institute's life, February 1960 to February 1961, we had some major problems to face, as did our members, since businesses in which they were engaged were feeling the recession.

The major problems confronting us during this past year were:

1) Financing the new Engineering Center.

2) Keeping our three almost autonomous societies working together and toward a stronger AIME.

3) Cooperation with other engineering societies—the Functional Plan.

4) Licensing and registration, and the Model Law.

5) The reorganization of the Council of Section Delegates.

6) Combatting the slump in the appeal of engineering to the young students.

THE NEW ENGINEERING CENTER

That we needed a new building to house the staffs of the many engineering societies had been obvious for many years. The present building was built in 1906 when the combined membership of the so-called "Founder Societies" was only 16,000. Our own membership alone is now 35,000, and the membership of the societies with offices in the building is over 200,000. Naturally the number of staff members has had to grow.

Although it was suggested that AIME move to Pittsburgh, the decision to stay in New York and to build a fine building on a prestige location opposite the United Nations Plaza was made by a competent and representative committee. Many of our members have complained that they should have had a chance to have a voice in this decision. This complaint is also unrealistic. Can you imagine trying to explain all of the ramifications involved to 30,000 (our then membership) and getting a decision from them that was reasonable and sound? We had to leave that decision to the experts and to men in whose judgment we had every confidence. Our representatives were H. DeWitt Smith, Harold Decker, and Clyde Williams. We could not have selected more wisely.

I was put in charge of fund raising from our members by then President Kinzel. I was not responsible for the total amount assigned to us; but nearly every other decision taken was mine.

It was decided to give each Section a quota or goal, and many of the Sections went to work diligently. The support of their Institute by members in such widely scattered Sections as Utah, Philadelphia, Oregon, Gulf Coast, Pennsylvania Anthracite, Hugoton, Lehigh Valley, St. Louis, Panhandle, Ohio Valley, Arizona, Hudson-Mohawk, Carlsbad, Florida, New York Petroleum, Uranium, Tri State, Montana, Fort Worth, Minnesota, Pittsburgh, San Francisco, and East Texas as of December 30, 1960 was most gratifying. The New York area, assigned a very high goal of $150,000, came through wonderfully. To date, the New York Mining and Metallurgical Section has contributed more than $140,000; the New York Petroleum Section has given over $13,000—a grand total exceeding $153,000.

After I became president I turned the chairmanship of the fund raising committee over to Lloyd Elkins, and he has beaten the drums loudly throughout the year. At the end of 1960 we called the campaign by Sections, over. We decided to make one more appeal, a personal solicitation by mail to every member with a letter signed by the president. This went out at the end of January.

As of February 28th (and I am sure that we have not received all of the replies from this direct appeal to all members) we had collected

From members in Mining and Metallurgical Sections	$307,911
From members in Petroleum Sections	110,343
From Foreign members, and from various committees and Sections, including the Woman's Auxiliary	67,456
Total (unadjusted)	$485,710

This left us still short of our quota of $500,000, but through the response to the President's appeal, this has been further reduced.

Editor's Note: Adjustments for cancellations, etc., totalling $6,810 must be deducted from the above amount, reducing the Grand Total (as of February 28) to $478,900. However, as of April 7, this adjusted total has increased to $483,214.

We have arranged to borrow the difference from the Jackling Fund, which was given by Mr. Jackling for the use of the building. We have drawn on it for office expense in connection with the accounting of the gifts from members; and we expect to draw heavily on it for new furniture and fixtures and for moving into the new building. We had hoped to keep the balance invested and use the interest to reduce our rent in the new building, which will be higher than the rent we have paid in the old building. Whether next year's Board will approve plans to refund this money borrowed to meet our current obligation has not yet been decided.

I want to take this opportunity to thank every member who has contributed toward this fund, and to the men in each Section who have worked so hard to raise the money. I want particularly to thank the ladies of the Woman's Auxiliary who contributed $16,236 without even being asked to make any contribution at all.

This combined effort not only of our members, but of so many engineering societies to work together toward one goal, has brought us much closer together. It has been a very unifying experience.

NEED OF COOPERATION AMONG AIME'S CONSTITUENT SOCIETIES

We have divided the Institute into three Societies, and this arrangement has been functioning well long enough for us to realize that it was a most wise move. We have learned from experience that although people are gregarious and like to flock together, there must be a considerable attraction of common interest to hold them together. In our Institute we have a wide spectrum of interests with the only common bond being that all have something to do with metals, minerals, and fuels that come out of the ground. However, you would have to bodily drag a physical metallurgist into hearing a petroleum paper; and an oil man has no interest whatsoever in minerals beneficiation nor in the people who find that subject interesting. One of our societies has four divisions; another, three; the third, only one; but that one is comprised of groups on water flooding, reservoir engineering, etc.

With all of this divergence of interest, it is important to ask what keeps us together; should we stay together; and how best can we promote better common associations? I think that there is no question about these points. We must stay together.

AIME has inherited prestige like that enjoyed by the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, and the American Institute of Chemical Engineers. Although many in each society are loyal only to the Society, nevertheless the majority of members consider that they belong to AIME and are proud of it. Our common interest in the Engineering Building, our membership in the Engineers Joint Council and in the Engineering Manpower Commission, the Engineering Foundation, and the Engineers' Council for Professional Development—are all unifying factors.

All recognize the axiom *in Union there is Strength*. Patrick Henry said, "United we stand, divided we fall." He had thirteen scattered colonies to weld together into a nation. We have seen the practical politics of uniting for strength in every facet of our living. We have enough divisive influences in the United States to try the patience of us all; and they do so try us. Nevertheless, we see the weakness of six countries in Central America and ten in South America, and the collapse in the Congo. In this day, you either work together or you fall together.

Inflation unites us. We can no longer afford a multiplicity of staffs, offices, meeting places, and publications. We must necessarily unite as much as possible. Repetition and multiplication of meetings, both technical and organizational, force too much of a burden on our time and our expense accounts.

We need a unifying central organization composed of the Board and officers of the Institute, the Secretaries, and the staffs, to hold our three societies together. During the year we settled a very important point, namely, that the Institute Secretary and his office would be paid uniformly by all members.

The Institute President is a unifying influence. This year I went to nearly every Section or meeting to which I was invited, and spoke briefly. I was there to prove the connection between that local meeting and the top Institute organization. The president, however, cannot do it all. Each officer of the Board of the Institute and of each Society as well as each member must say to himself, "I am a member of AIME." We can have our own points of view and express them as forcibly as possible, but we must recognize that others are as sincere in their views and we must be tolerant and listen to them. Perhaps, after all, we ourselves are a bit stubborn and will have to give in a little.

INTER-ENGINEERING SOCIETY RELATIONS

There is no doubt that the Engineers Joint Council has increased its prestige, particularly under Gus Kinzel's leadership. This will increase this year with Mr. Landis as president and Dr. Holbrook re-elected as vice-president. The prestige of ECPD is established and is continuing. We can be proud to be represented on its board.

EJC has set up a new committee to coordinate technical programs and meetings to avoid geographical overlapping, as well as technical overlapping. It will take some time for this committee to be effective, but it should have a strong unifying influence eventually.

EJC has applied to the Department of Internal Revenue to be classified as 501 C-3. If it is given that status, then EJC cannot engage in various types of activities that are generally classed as "lobbying", or those that benefit individuals rather than the public.

It has been proposed by the Electrical Engineers, (and in that recommendation they have been joined by the Mechanical Engineers) that the National Society of Professional Engineers be set up in its relation to the other societies as EJC is for technical matters, and as ECPD is for educational matters,—i.e., to be the "political arm" of the engineering societies. This scheme is called the "Functional Plan;" and the Electricals, Mechanicals and, of course, NSPE have been putting pressure on us to support it.

However, NSPE is a society of individual members and cannot accept society memberships as do EJC and ECPD. The latter two are run by a Board on

which each member society has representatives. NSPE is run only by and for its own members. To be a member of NSPE one must be a licensed and registered engineer. No member of AIME can join NSPE unless he is registered, and only a very small number of our members are. Hence we cannot support the Functional Plan to direct NSPE to look out for the political life of our members, since we have no way of telling the Board of NSPE what we want done, and no influence to get them to do anything for us.

We have studied NSPE and have had observers at recent meetings. We believe that the officers and directors are sincere and intelligent men, devoted to the benefit of the engineering profession. If they will open their membership to members of AIME, it is my opinion that we should urge our members to join in sufficient numbers to influence the councils of the State Societies and the national organization. Then our geologists, mining engineers, metallurgists, and petroleum engineers would belong as individual members to a strong organization which could look after their "political lives."

We have examined the registration laws in all of the states and have learned that our members can get registered in many states. It is my opinion that we should urge all of those who can register to do so; and once registered, they can join NSPE.

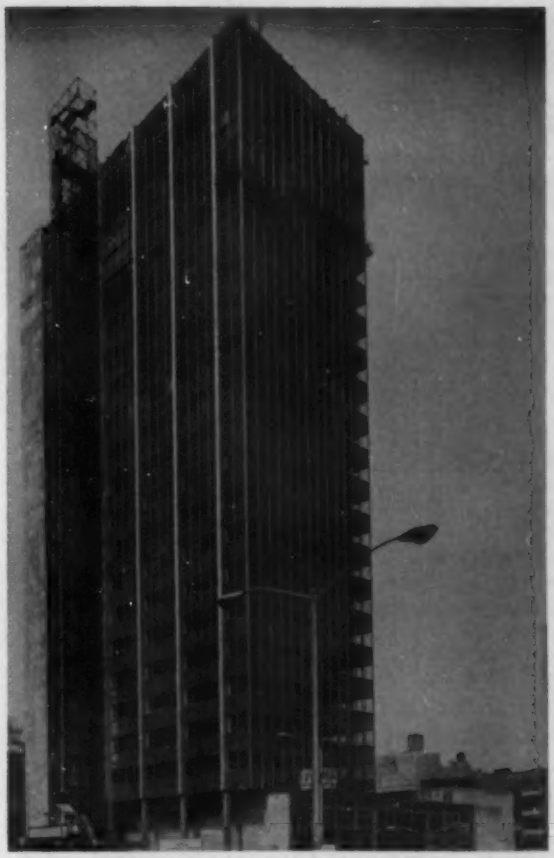
LICENSING AND REGISTRATION

We have studied the licensing and registration laws in each state. Although drawn especially for civil, mechanical, and electrical engineers, nevertheless, geological engineers can be registered by taking an examination in their field of competence in 15 states; mining engineers in 27 states; metallurgical engineers in 28 states; and petroleum engineers in 19 states. Older men with a number of years of practice in positions of responsibility can be registered under what is called the "eminence clause."

Many people believe that requirements for registration and licensing of engineers will become almost universal in 15 years. The fact that a very large number of companies, both large and small, are obtaining contracts with the government for some phase of our National Defense program causes a substantial number of engineers to become involved in what is called "the public health and welfare." Most of our engineers employed in industry have seen no reason for registration, and in most states they do not have to be registered. However, lots of things can and do happen. A company might dump chemical or radioactive wastes into streams or into the ground and be sued in court for damages. One of the first questions asked of the expert for the company could be, "Are you a registered engineer?" If the answer be "No," the "expert" is likely to be excused and not permitted to testify further.

As persons advance in companies to positions of responsibility, there will be more and more demands that those senior persons be registered. If they have neglected to take the basic examination in fundamentals upon graduation from engineering school, they are going to find it increasingly difficult to pass examinations in the fundamentals of mathematics, physics, and strength of materials.

This is why we urge our student members to take the basic examination in fundamentals (the so-called "Engineer-in-Training" examination) just as they graduate when all of that technical material and mathematics is fresh in their minds. Senior engineers who can become registered in many states under the so-called "eminence clause" should do so as soon as possible.



As shown in this recent photograph, the exterior of the United Engineering Center is virtually complete. AIME offices will be located on the 13th and 14th floors.

The National Council of State Boards of Engineering Examiners (NCSBEE) has been working on a "Model Law," and had hearings in New York and Portland last year. We had observers at each of those meetings. We could subscribe to nearly every section of the proposed Model Law except that we felt that it should specify that a man be examined in his field of competence, not just in "engineering." We have accepted the Model Law on condition that our "competence clause" be included in it. We learned that to be admitted to the discussions at the NCSBEE, we should be a sustaining member of that organization. We have voted to pay the annual fee of $500 to permit AIME to be a sustaining member.

Naturally, this Model Law is not going to be accepted without amendment by the legislatures of fifty states; but at least it is a guide for each to follow. We hope and believe that by working with the State Boards and the NCSBEE we can further their recognition of our fields of engineering.

Our conclusion is that, like it or not, universal registration of engineers, both in industry and in private practice, is inevitable; and when something is inevitable, you had better adapt yourself to it. If it involves passing examinations which are simple for our college graduates, let them take such examinations. Our problem is to get the state boards to recognize that the technology of this rocket age is exploding, and the definition of an engineer made in

the 1920's or 1930's is out-of-date. There are geological, mining, metallurgical, and petroleum engineers, as well as civil, electrical, and mechanical.

COUNCIL OF SECTION DELEGATES REORGANIZATION

Our Council of Section Delegates has grown from a small intimate group when we had only 35 or 40 Sections to a large and unmanageable group. For many years their sole subjects for discussion were administrative matters instead of matters dealing with Section affairs and membership problems. Many members both in the Council and on the Board have been feeling for a long time that some change should be made. Last year the Council itself voted to ask the Board to appoint a Committee charged with studying the problem of reorganization of the Council.

The Board appointed a committee consisting of Messrs. Don Johnson of Tulsa, Bob Grogan of Wilmington, Delaware (who has been the current chairman of the Interim Committee of the Council itself), and Walter Carroll of Cleveland. The committee could not agree on a recommendation and came in with a majority and a minority report.

The Board released these two reports to the Sections, and the Council of Section Delegates debated the subject at their meeting in St. Louis. Their recommendations are now before the Board for further consideration.

COMBATTING THE SLUMP IN THE APPEAL OF ENGINEERING TO THE YOUNG STUDENTS

Registration of new students in the freshman and sophomore classes of most of the engineering schools is below a year ago; and in some of the disciplines in our fields of interest, the drop is very serious indeed. At the Massachusetts Institute of Technology, students enrolled in science exceed in number, for the first time those enrolled in engineering. Many feel that the swing is cyclic and that the number of students enrolling in the engineering courses will be back to normal within a year or two. Right now we are in the glamor of the rocket age. Scientists designed the rocket. If it failed to go into orbit, the fault was the engineer in the dirty overalls who did not build it correctly.

All of these boys cannot make a career in pure physics and mathematics since there cannot be enough jobs for them. They must combine their physics and mathematics with engineering since that is where there will be an adequate number of jobs.

We in the Engineering Societies, however, cannot just sit idly by, wringing our hands and hoping for the best. What can we do that will be effective? Reaching 250,000 boys in 25,000 high schools is a frustrating problem. We have alerted our Sections and of course most of them were aware of the situation before. Visits to the high schools by well-chosen engineers and talks about the opportunities in engineering may help.

We are studying how to assist two or more organizations which are now in existence trying to help the high schools arouse an interest in science and engineering in their students. The one that appeals to us most is called "Jets" (Junior Engineering Technical Society, Inc.). This organization was founded by the Dean of Engineering at Michigan State University in Lansing. Two of our prominent members, J. C. Calhoun, Vice-Chancellor of Texas A. & M., and Julian Feiss of Kennecott Copper Corp., have been serving on the Board of Directors of "Jets." The student groups in the high schools are called "chapters," and the number of these is growing very rapidly. From a start in 1950, there were 200 in June 1957, 500 in June 1959, and 650 in June last year.

We have not yet been asked for money to support the program, but rather for help in preparation of material which the national office in Lansing sends out to all of its chapters. For instance, on April 12, 1961, they mailed out a packet on Geology and Mineralogy; and in May, at their National Engineering Project Exposition, there is a section on Petroleum Engineering. Projects are theses, models, etc. which students prepare for awards.

Other organizations actively working in the high schools are "Jessi" (Junior Engineers Scientists Summer Institutes) and "FSA" (Future Scientists of America). The former puts on summer school programs for high school students, the second promotes prize paper contests.

MEMBERSHIP

In a recession year, applications for new memberships are at a record high, but losses are also up. As a matter of fact, however, our gross gain was greater than in any previous year, as follows:

Mining	1455 members	34.25%
Metals	1016 members	23.92%
Petroleum	1777 members	41.83%
	4248 members	100.00%

Our losses were higher than previously, but percentage-wise were about the same as in the last two years. Percentage loss of membership at the end of 1958 was 7.22%; of 1959—7.92%; of 1960—7.95%.

We cannot do anything about losses from death, and as the Institute grows, this number must increase numerically. Remember that we have increased our membership from 14,922 in 1940, to 21,616 in 1950, to 36,745 in 1960. The increase in membership between 1940 and 1960 is 1½ times the membership in 1940; and the increase in membership in the ten years 1950 to 1960 is a number greater than the total membership in 1940 and is 75% of the membership in 1950. Since the 75% increase over 1950 is a net increase, considerably over 50% of the current members have been members less than 10 years.

Nevertheless, losses are a major problem. With a rapidly growing organization, a large number of members have been in such a short time that they have developed little of the loyalty that comes from long association.

CONCLUSIONS

The Institute has had a successful year, particularly in accomplishing its main purpose of bringing meetings within the geographical and financial range of more of our members, and of publishing a large number of excellent papers in our journals, transactions and other books.

ADDITION TO COLLEGE LISTING

In the listing of colleges and universities accredited by ECPD which appeared on page 157 of the February issue of MINING ENGINEERING, the University of Washington, Seattle, Wash., should be added to those schools offering degrees in Metallurgical Engineering.

RESULTS OF 1960 QUESTIONNAIRE

ON ADMINISTRATION OF STATE ENGINEERING REGISTRATION LAWS

The following is a summary of the answers received to six questions that were sent to each state. To date, Indiana, Iowa, and Virginia have not responded to the questionnaire.

1. Do you register all engineers in one category of Professional Engineer?

YES: Ala., Ark., Colo., Conn., Del., Ga., Idaho, (with qualifications) Ill., Kan., (with notation of specialization) Me., Md., Miss., Mont., Neb., (with qualifications) N. H., N. J., N. M., N. Y., N. D., Ohio, Okla., S.C., S.D., (with qualifications) Tenn., Texas (but 4 categories), Wis., Fla.; Missouri replied no answer could be given.

NO: (Would qualify geologists): Minn., Nev., and S.D. (Would qualify metallurgists): Ariz., Ky., La., Mass., Mich., Ore., S. D., Wash., W. Va., District of Columbia. (Would qualify mining engineers): Alaska, Ariz., Ky., Mass., Minn., Nev., Ore., Pa., Utah, S. D., Wash., W. Va., District of Columbia. (Would qualify petroleum engineers): Ariz., Calif., Ky., La., S. D., W. Va.

2. On the examination in the fundamentals of engineering (some States called it "Engineer in Training Examination") are there questions in various fields of engineering and, if so, is there a voluntary selection of alternative questions permitted?

NO: (Not any voluntary selection): Ala., Alaska, Ariz., Conn., Del., Fla., Ga. (But some optional questions), Mass., Mich., Miss., Mont., Neb., Nev., N. M., N. Y., N. C., Ohio, Ore., Pa., S. C., Tenn., Texas, W. Va.

YES, but only in Civil, Electrical, and Mechanical Engineering fields: Ark., Calif., La., Me., N. J., Wash.

Those which permitted voluntary selection including our fields of interest: Calif., (petroleum only), Colo., Idaho (mining only), Ill. (all but geology), Kan., Minn. (all but petroleum), N. D. (mining and petroleum only), Okla., S. D., Wis., Wyo. (mining and petroleum only), District of Columbia.

3. Does the subsequent examination (in many cases given four years after the basic examination, if that is taken upon graduation) permit the candidate to select questions in his field of competence?

States permitting selection in geology: Ark. (has had no applicants), Colo., Del., Kan., Minn., Mo., Mont., Nev., N.M., N.D., N.C., S.D., Texas, Utah, District of Columbia.

States permitting selection in metallurgy: Ala., Ariz., Ark., Colo., Conn., Del., Fla., Kan., Ky., La., Mich., Minn., Miss., Mo., Mont., Nev., N. H., N. M., N. C., Ohio, Ore., Pa., S. C., S. D., Texas, Wash., W. Va., Wis., District of Columbia.

States permitting selection in mining engineering: Alaska, Ariz., Ark., Colo., Del., Fla., Idaho, Kan., Ky., La., Minn., Miss., Mo., Mont., Nev., N. M., N. C., Ohio, Okla., Ore., Pa., S. C., S. D., Texas, Utah, W. Va., Wis., Wyo., District of Columbia.

States permitting selection in petroleum engineering: Alaska, Ark., Calif., Colo., Kan., Ky., La., Md., Miss., Mont., N. M., N. C., Ohio, Okla., S. D., Texas, Utah, W. Va., District of Columbia.

4. Does the State register engineers on the basis of a degree from an accredited engineering school and after some years of engineering practice, without taking an examination in the fundamentals of engineering?

YES: Ala. (4 years), Calif. (eminence clause), Colo. (after 15 years), Conn. (15 years), Del. (4 years), Fla. (very rare), Idaho (after 4 years), Kan. (after 4 years), Ky. (after 4 years of acceptable practice), La. (after 5 years), Me. (after 4 years with interview), Mass. (after 4 years), Miss. (after 4 years), Mont. (after 12 years), Neb. (in special cases), Nev. (after 20 years), N. H. (12 years), N. C. (after 8 years), Okla. (3 years), Pa., (4 years), S. C. (after experience acceptable to Board), Tenn. (after oral examination), Texas (8 years), Utah (12 years), Wis. (after 12 years), Wyo. (25 years), District of Columbia (after 12 years, applicant must appear for interview).

5. If the State does not require an examination in the fundamentals for engineers with experience (i.e., those which replied "YES" to Question 4) does it require a written or oral examination in the engineer's field of experience?

YES: Colo., Fla., Ga., Idaho, Ky., La. (if not from accredited college), Me. (rarely), Mich. (had replied NO to Question 4), Mont., Neb., Nev. (usually), N. H. (at Board's option), N. J. (oral), N. M. (written), N. C., Okla. (after 20 years), Pa., S. C., S. D., Tenn., Utah (after consideration by Board), W. Va., District of Columbia (oral).

6. Can an engineer licensed and registered in any one of the other States, and as a result of examinations in those States, be licensed in this State without taking an examination in fundamentals or in the field of specialization?

YES: (if the examination in the other States was equivalent to theirs): Ala., Alaska, Ariz., Ark., Calif., Colo., Conn., Del., Fla., Ga., Idaho, Ill. (with qualifications), Kan. (probably after interview), Ky., La., Me., Md., Mass., Mich., Minn., Miss., Mo., Mont., Neb. (if registered in other States before Dec. 28, 1959), Nev., (must appear for interview), N. H., N. M., N. Y., N. C., N. D., Ohio, Okla., Ore., Pa., S.C., S. D., Tenn., Texas, Utah, Wash., W. Va., Wis., Wyo., District of Columbia.

VINCENT DENIS PERRY

FOR HIS CONTRIBUTIONS TO GEOLOGY AND GEOPHYSICS, HIS LEADERSHIP IN THEIR APPLICATION TO THE FINDING AND DEVELOPING OF MINES, AND FOR HIS LECTURE

"THE SIGNIFICANCE OF MINERALIZED BRECCIA PIPES"

(Inscription, 1961 D. C. Jackling Award)

". . . . I have heard it said that it is the prospector who finds our mines, not geologists. Yes, prospectors are the men who discovered and located the thousands of surface mineral showings, of which many developed into mines, but it is also true in many cases that it took the experienced geologist to interpret the prospector's mineral showings with sufficient understanding to predict their underground ore possibilities . . . I think I can say in truth that no individual has more completely devoted his lifework to the study of mining geology and the science of ore deposits . . . with greater success to the finding and development of mines than has Vincent D. Perry." *Reno H. Sales, Presentation Address of 1961 D. C. Jackling Award.*

THE SIGNIFICANCE OF MINERALIZED BRECCIA PIPES

by VINCENT D. PERRY

Mineralized breccia pipes, because of their widespread occurrence and close structural relations to some of the world's great ore bodies, are objects of unusual interest for mining engineers and geologists. The literature contains many references to them, but it is questionable whether their genetic significance and economic importance have been sufficiently emphasized. The purpose here is to stress these features, relating them to the field facts, for the particular benefit of younger generations of geologists who, confronted with and sometimes confused by the growing flood of geochemical, geophysical, and other specialized research approaches, may be reassured that mappable field relations remain a foremost guide to a better understanding of ore deposits.

A mineralized breccia pipe is a pre-mineral, breccia structure which has controlled the circulation and deposition of subsequently introduced mineralization. It is composed of relatively rotated angular or rounded rock fragments, set in a mineralized matrix. A pipe in plan outline may be circular, oval or approach polygonal form, with a steep to vertical axis proportionately much greater than its horizontal dimensions. The pipe is a steeply plunging, chimney-like mass of brecciated rock cemented with later minerals.

Rock breaks in a variety of ways and complete fragmentation often occurs without rotation of individual pieces. A finely broken rock mass may fit into a tight jig-saw pattern, each fragment having mutually concordant boundaries with its neighbors. The result is a stockwork of innumerable reticulating cracks that, once cemented by mineralization, forms a complicated intersecting network of individually insignificant but collectively important seams and veinlets. Stockwork fracturing among its many forms takes the shape of domes of subsidence, fracture pipes, and related peripheral zones around and over breccia columns, or a combination of any of these structures.

The significance of the mineralized breccia pipe is that it represents the extreme or climactic expression of a structural type which has a variety of mutations including subsidence domes, fracture pipes, and other stockwork zones all with related ancestry and similar to dissimilar characteristics. These allied and associated structures hold an answer to the fundamental question of the origin of many important ore deposits.

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CANANEA—TYPE LOCALITY FOR BRECCIA PIPES

The Cananea district is characterized by an unusual development of mineralized breccia pipes. It is an important copper producer located in Sonora, Mexico, a short distance southwest of Bisbee, Arizona, and at the southerly limit of the great porphyry copper belt of the southwestern U.S.

Cananea's rocks consist of Paleozoic quartzite and limestone capped unconformably by a thick series of volcanics including andesitic flows, tuffs, and agglomerates. These rocks have been intruded by a deep-seated granite with related basic and acid differentiates including dikes and plugs of quartz monzonite porphyry. Mineralization coincides with a northwesterly trending belt of these intrusives which break upward into and through the sedimentary-volcanic rock sequence.

The district has weakly defined tectonic alignments in a northwesterly direction with subordinate intersecting fracture elements, but lacks important faulting or fissuring to provide throughgoing avenues for the upward circulation of mineralizing fluids. Thus, as will be discussed in subsequent paragraphs, the alternate way in which late magmatic and hydrothermal derivatives of the parent magma reached the near-surface zone was by excavating their own breccia pipe channelways.

There are numerous stages of breccia pipe development, related both in time and space to magmatic activity. A compilation of similarities and differences in various pipes suggests that proximity or remoteness of a demonstrable or inferred magmatic source provides an orderly genetic basis for describing the following representative types.

Cananea Duluth Type: There are no intrusive rocks within or close to the Cananea Duluth pipe; therefore, the existence of any deep-seated magma that may have been related to its formation must be inferred. The structure is an oval-shaped ring 1200 x 300 ft in plan dimensions, cutting steeply across low angle, bedded tuffs, and other volcanics; it has been developed by drill holes to a depth of 2000 ft below the surface. The ore follows the periphery of the pipe and is composed of intensely brecciated rock which is cemented by minor galena, sphalerite,

chalcopyrite, quartz, carbonates, and adularia. There is a definite vertical zoning of sulfides with less galena, continuing sphalerite, and increasing chalcopyrite at deeper levels. Within the interior of the ore ring, the brecciation becomes progressively weaker and coarser, the whole indicating relatively gentle slumping with broken, thin tuff beds preserving a flat, slab-like orientation within the breccia. Large vugs, which are often lined with crystals of quartz and carbonates, are distributed through the central core.

The influence of tectonic lines of weakness in predetermining the configuration of the walls of a pipe is well illustrated by local modification of the outline of the structure at deeper levels. The pipe in depth assumes a somewhat angular, polygonal shape determined by the attitude of regional intersecting fracture planes. However, at each intersection the pipe boundary curves gradually from one fracture plane to the next, thus rounding off the corners and preserving a rudely elliptical enclosure.

Capote Type: The Capote mine had one of Cananea's first high-grade orebodies. On the upper levels, the ore was localized as a relatively flat, easterly dipping, limestone replacement deposit which changed downward into a well-developed oval of brecciation cutting through an underlying thick section of quartzite and continuing into granite. At the deepest level (1600 ft below surface) and in drill holes 600 ft below the bottom level, the breccia pipe is confined to granite wall rock and is filled with sub-angular to well-rounded granite and quartzite fragments. Since the base of the quartzite formation outside the pipe is 1100 ft below the surface, the quartzite fragments within the breccia chimney must have slumped downward a minimum of 1100 ft to reach their present location as exposed in the deepest drill holes. All the rock fragments are tightly cemented with chalcopyrite, bornite, chalcocite, quartz, and carbonates.

These field relations clearly indicate major downward slumping within the steeply dipping breccia walls, and this slumping must have worked upward to a few hundred feet below the present surface where the highly mineralized Esperanza limestone is relatively unbrecciated. Strong hydrothermal copper mineralization similar to the type that formed the mineral assemblage at Butte, Mont. and Bisbee, Ariz., cemented the intensely brecciated, rounded and chaotically jumbled fragments in the pipe and, extending upward, replaced the overlying limestone.

The Oversight orebody, 2000 ft southeast of the Capote pipe, resembles it in many details. At the bottom level 800 ft below the surface, angular to rounded limestone fragments from beds several hundred feet higher have evidently slumped deeply into the pipe.

The 301 Breccia is another pipe with characteristics similar to those of the Capote. It is located in the southeast part of the district and shows intense brecciation with pyrite and quartz, often of vuggy character, filling interstices between jumbled angular fragments of porphyry and volcanics. The breccia walls are sharp and converge upward, indicating a now eroded dome-like roof a few hundred feet above the present surface. The breccia itself is below commercial grade to depths thus far developed, but an adjacent orebearing pipe located several hundred feet to the north, and a large oval-shaped area of highly shattered, chalcocite-enriched porphyry and volcanics surrounding both pipes, constitute the largest tonnage of open pit copper ore found to date at Cananea. Underground, there is an excellent exposure of a later porphyry dike cutting the breccia and indicating late-stage magmatic activity.

East Breccia Type: Several structures of the East Breccia type occur at Cananea. The first of them discovered, the East Breccia, is located adjacent to and immediately northeast of La Colorada ore pipe and occurs within a zone of contact brecciation in which irregular tongues and dikes of quartz monzonite porphyry penetrate and engulf fragments of earlier volcanic rocks.

A distinctive feature of the East Breccia is its upward termination as two separate prongs that occur beneath a roof of unbrecciated rock. Its easterly summit has a dome-like top, capped by unbrecciated volcanics, about 400 ft below the present surface; the westerly part has a sub-surface apex 800 ft deep and lying beneath unbroken quartz monzonite porphyry. The two parts extend downward below these apices to a junction about 1200 ft below the surface, and at deeper levels the whole system is a single pipe with plan dimensions approximately 800 x 300 ft.

The breccia is composed of broken, angular to sub-angular fragments of highly sericitized porphyry and volcanics cemented together by a fine-grained aggregate of granular, glassy quartz, pyrite, chalcopyrite, and molybdenite.

Much of the ore occurs as secondary chalcocite in the breccia at the top of the pipe, and in a stockwork fracture zone of unbrecciated rock above and surrounding its cupola-like roof. From an ore control viewpoint, the breccia pipe structure and the stockwork zone immediately above it are integrated into a single body. At deeper levels, primary chalcopyrite and molybdenite of ore grade occur along the easterly margin of the pipe. This primary ore shoot tapers downward to non-commercial values, but the breccia structure continues in depth.

GENESIS OF CANANEA PIPES

The literature contains many references to breccia pipes. Augustus Locke[1] contributed an important paper many years ago wherein he concluded that they are formed by subsidence caused by a net removal of rock inside the pipe. He believes the removal resulted from corrosive action of early solutions, followed by a cycle of mineral deposition and replacement within the column of rock fragments.

There is abundant field evidence at Cananea to support the principle of subsidence, but Locke's theory requires a combination of relatively soluble rocks, reactive solutions, and an open system of circulation to provide leaching, transportation, in addition to excavation and removal of large amounts of material to form important breccia columns. Solution slumps in limestone, forming ring-like zones, may develop by such a process. However, there are two critical features of Cananea pipes which require a more suitable explanation. First, some of the pipes show remarkably large downward displacement of fragments. This fact, combined with the great volume increase due to intense brecciation, calls for removal of large volumes of material. Second, the closed tops of certain pipes demonstrate that these large volumes were not evacuated from the top of the pipe; the inescapable conclusion is that withdrawal must have occurred at the bottom.

To provide for such removal at Cananea, R. B. Mulchay has advocated a subsidence or slump mech-

The panorama at Cananea. In the foreground is the concentrator plant which has a capacity of 16,000 tpd.

anism resulting from decreased magma pressure at localized points above the roof of a batholith. He states in an unpublished paper:

> "It is believed that a more rapid encroachment by the magma in a particular area might lead to a relative lessening of pressure at other points of attack. In these areas of relatively decreased pressure, local slumpage of roof rock into the magma reservoir could take place and start formation of breccia chimneys. Repeated magma advances at various points and resultant slumpage in the chimneys would eventually extend the breccias to or near the surface."

In the first Jackling Lecture, which was given by Reno Sales[3] and entitled "Genetic Relations between Granites, Porphyries and Associated Copper Deposits," the role of quartz porphyry intrusion as the vanguard of the mineralization process is stressed. He considers the first break-through of quartz porphyry a critical step in setting up a focal point for differentiation of aqueous fluids within the magma. Subsequent crystallization of the quartz porphyry closed the magma system, permitting further segregation and concentration of the ore fluids. At Butte, these fluids were ultimately tapped by successive stages of fissuring; at Cananea there was a lack of strong regional fissuring, but in time, vapor build-up at high points under the roof of the batholith started a collapse process that proceeded simultaneously with introduction of the mineralizers.

The tendency of Cananea pipes to cluster around the margins of intrusive quartz porphyry plugs is an indication of close affinity between pipes and intrusives. The youthful stage of magmatic activity is a process of rising intensity and upward advance along various zones and areas of weakness in the earth's crust. Positive upward surge of the magma along preferred structural conduits finally culminates in break-through to the surface and volcanic activity. This volcanic activity, progressing in time and volume, would fundamentally alter the isostatic balance in a connected magmatic reservoir. In his paper entitled "Calderas and their Origin," Howell Williams[5] describes volcanic craters as positive forms and refers to calderas as collapse or negative areas over an exhausted magma chamber. Craters typify an active growing period, while calderas are a mark of decadence and age. His paper is an excellent description of the formation of calderas by the withdrawal of magma followed by subsidence and ultimate foundering of the roof of the magma chamber.

Volcanic explosion or fissure eruption can cause more than simple caldera development. The author's interpretation of Mulchay's idea of magma withdrawal and subsidence is to correlate, in an opposite or reciprocal sense, repeated pulses of dying volcanism and growing internal localized subsidence within a single connected magma system. A corollary is that end-stage aqueous magmatic fluids will concentrate from the magma at points of reduced pressures near the tops of subsidence columns.

W. S. Burbank[4] has described the close space and structural relations between the Silverton caldera and the breccia pipes of Red Mountain, Colo. Billingsley and Locke[6] have referred to the repeated occurrences of Tertiary volcanic formations in proximity to important Tertiary mineral districts in western U. S. The parallelism of the South America porphyry copper belt and the adjacent Andean volcanic chain from Peru to central Chile suggests a genetic connection between the great ore deposits and nearby volcanic features. The regional relations suggest volcanic eruption and magma loss as a reason for collapse, subsidence, and consequent concentration of mineralizing fluids. The subsidence effects, preceded by porphyry invasion, would be localized at specific high points controlled by regional tectonics beneath the hood of the crystallizing batholith. Obviously, these conditions and relations are not simple, but we may speculate on a number of factors, combinations of which account for the individually distinctive character of various subsidence structures.

Withdrawal of magma presumably would upset pressure balances and focus subsidence on weak points in the roof rock. Net effects would depend on a number of conditions, some of which are:

1) **Horizontal area of the unsupported roof.**
   a) Withdrawal from the entire reservoir roof will cause cauldron subsidence.
   b) Reduced pressure over a large magma column projecting above the general roof will produce unit subsidence and domical fracturing.
   c) Reduced pressure over small cupolas, with selective high upward penetration, will cause maximum fragmentation, downward slumping, and restricted breccia columns.

2) **Amount of magma withdrawal.**
   a) Slight magma withdrawal may be sufficient to upset mechanical equilibrium, cause domical subsidence, and promote the collection of mineral fluids.
   b) Continued withdrawal will further reduce pressures and produce intense brecciation with additional concentration of end-stage mineralizers.

3) **Rate of magma withdrawal.**
   a) Rapid removal will produce unit or domical subsidence.
   b) Slow withdrawal and pressure reduction will permit spalling, fragmentation and brecciation.

4) **Timing in the magma cycle.**
   a) Quartz porphyry intrusion and crystallization initiates collection of mineralizers.
   b) Early subsidence may be slight and cause domical fracturing.
   c) Breccia columns above small, localized cupolas develop later as reduction of pressure continues either steadily or intermittently.

5) **Strength of rock.**
   a) Hard, competent rock will favor formation of subsidence domes and large voids.
   b) Differential hardness of certain beds or rock ribs will provide localized arch resistance and subsidence of less competent rocks under the arch.
   c) Planes of fracturing and other lines of structural weakness will determine positioning of the cupola and will divert, confine, and control the subsidence dome or breccia column from vertical to an angle of accommodation with the force of gravity.

6) **Depth of the cupola with relation to the surface.**
   a) Shallow depth with low superimposed rock load will result in maximum open spaces and caves. The "vaulted dome," an open or readily dialated space at the base of La Colorada, which will be described later, may have been a near-surface phenomenon.
   b) Medium depth should give reasonably coarse to fine brecciation with voids between the rock fragments.
   c) Great depth will result in fine fragmentation and elimination of voids.

7) **Break-through of subsidence to the surface.**
   a) Presumably upward advance of a caving breccia column would come to a halt in competent rock at some distance below the surface where rock strength would be sufficient to establish mechanical equilibrium and support. This situation could explain the "topping-out" of certain Cananea pipes close to the present surface.
   b) If the overlying rock failed to the surface, either crypto-volcanic activity with gas blow-out would occur or the magma advance, due to load relief, would be resumed, eruption would take place, and the breccia pipe would be filled wholly or in part by a volcanic neck of intrusive rock.

8) **Amount of vapor release from the magma.**
   a) Vapor release conceivably could build up sufficient pressure to support the roof and terminate slumping and brecciation.
   b) Vapor pressures could provide an up-thrusting force capable of rupturing the top of a subsidence arch, particularly if the surface were close enough to provide relief.
   c) The rebrecciation of rock and its injection as a finely comminuted semi-fluid medium is an end-stage result of accumulating vapor pressure and its release.

9) **Amount of vapor escaping to surface.**
   Catastrophic break-through of gas to the surface could explain the evidence of comminution, rounding, chaotic mixing, and churning of breccia fragments observed as a late or end-stage effect in many pipes.

Combinations of different factors listed above can be correlated on a genetic basis to demonstrate a common ancestry for two broad types of mineralized subsidence structures.

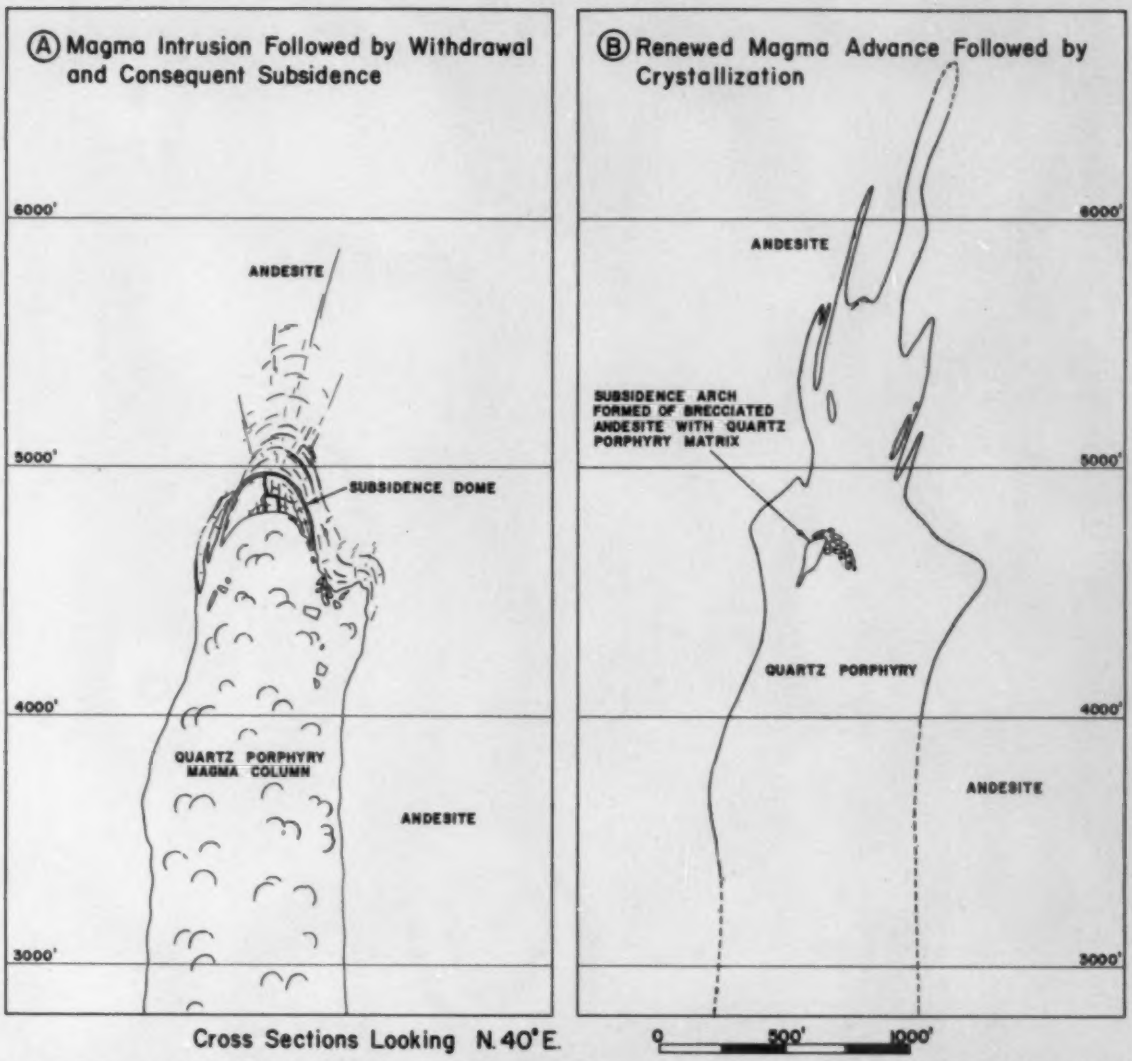
1) **Mineralized porphyry structures.**
   Stockwork fracturing forming a thin and broad or deep and narrow domical shell of subsidence will occur in competent rock early in the cycle with slight but rapid pressure drop over relatively large cupolas. The activity is preceded by one or more preliminary stages of porphyry intrusion.

2) **Mineralized breccia pipes.**
   Localized fragmentation, forming steep breccia columns, in some cases controlled by tectonic zones of weakness, occur later in the cycle due to continued but slow reduction of magma pressure over small areas and at medium to substantial depths.

Cananea's breccia pipes belong to the latter group and are the result of intense local fragmentation forming deep-seated subsidence columns along predisposed lines of structural weakness over restricted magma cupolas. The subsurface tops of many pipes may be explained as a mechanical phenomenon related to shallow depth. The caving tendency will become progressively less with decreased rock load and may be finally stopped by the superior strength of competent rock. Internal support may also come from the inflationary pressure of vapors generated by the mineralization processes at the top of the breccia pipe.

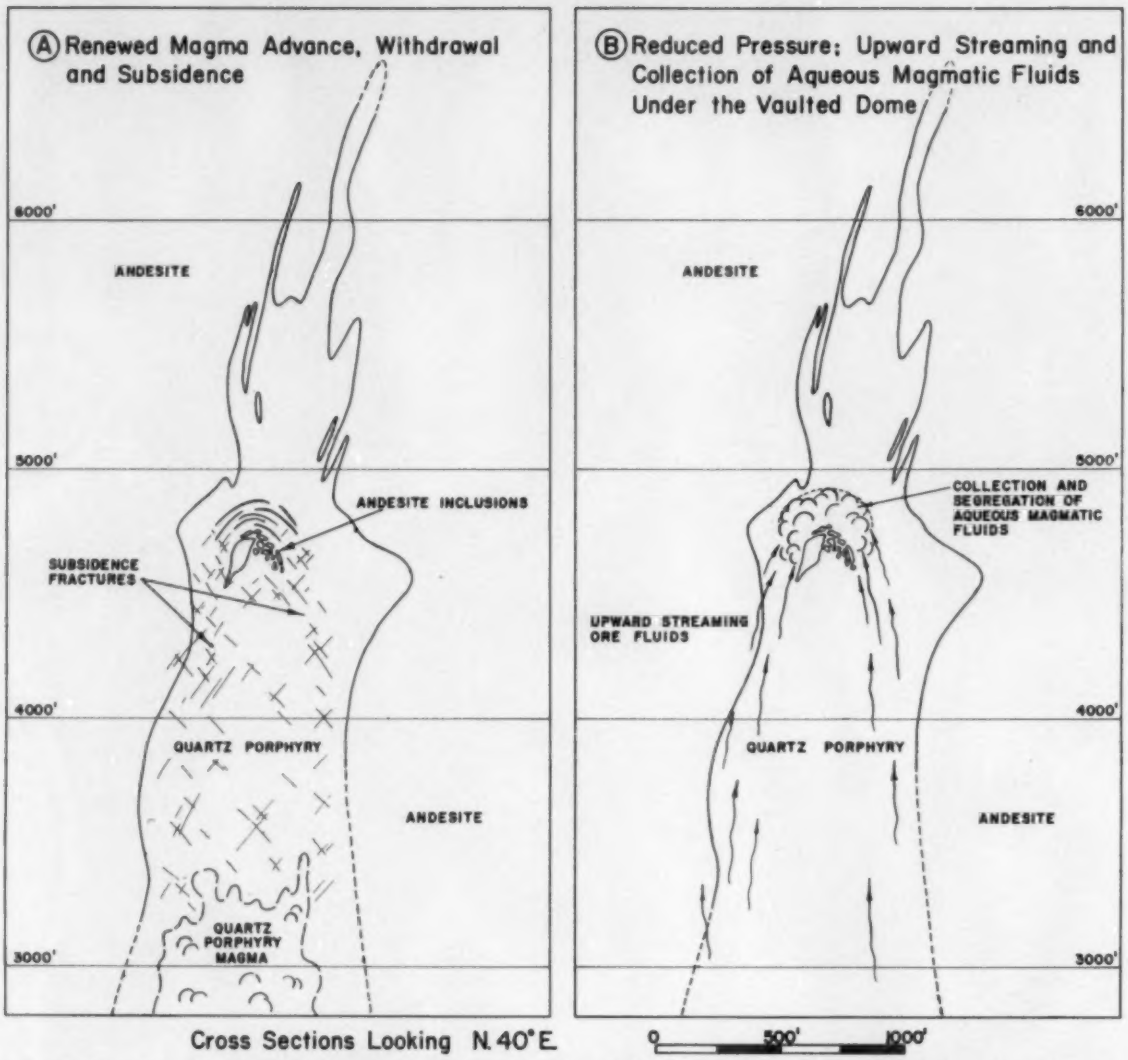
NATURE AND ORIGIN OF CANANEA'S LA COLORADA PIPE

Among the Cananea breccia pipes, La Colorada pipe is distinctive and extraordinary. It combines a deep extension of low grade copper mineralization typical of porphyry copper structures, an upward expanding fracture cone or pipe containing high grade sulfide, and a near-surface stockwork of enriched secondary ore to make it one of the world's richest and most unusual ore deposits. The Cananea District has produced 2.8 billion pounds of metallic copper, and slightly less than half of it has been mined from La Colorada; its deep unmined downward extension contains additional important copper content.



Origin of La Colorada Ore Pipe—*Formation of Pre-Porphyry Ore Dome (Stage 1). Diagram* A *illustrates intrusion of quartz porphyry magma, followed by pressure reduction and consequent subsidence forming a semi-ellipsoidal fracture dome above the magma column. Diagram* B *shows renewed magma advance and crystallization of the porphyry around and above the fracture dome.*

The field evidence shows a close spatial relation of the orebody to an isolated plug of quartz monzonite porphyry. The ore fluid, composed of silica, copper, iron, and sulfur, with water and other components, was derived from a deep source within the porphyry. Drilling to an approximate depth of 1500 ft below the bottom level, as described by Velasco and Sevilla,[8] has revealed an important deep downward extension of low grade copper mineralization. The structural elements of La Colorada ore pipe have been discussed by this author in the Lindgren Volume *Ore Deposits of the Western States.*[7] The critical feature of the primary pipe is a dome-like structure of brecciated volcanics capped by massive porphyry, which occurs at the base of the high grade orebody. It separated the ore pipe into upper and lower structural elements and, when rebrecciated, formed a vaulted dome which became the focal point for ore fluid accumulation. Within it, the fluids segregated into component silica, silicates, and sulfides which were injected successively into a subsidiary fracture cone, approximately 1000-ft high, that formed as a result of stresses produced by accumulating vapor pressures above the locus of differentiation. Pegmatitic quartz crystallized as an outside shell around three-fourths of the periphery of the fracture cone. Copper sulfides and molybdenite followed the quartz and were deposited as a network of veinlets lacing the quartz and wall rock, and as a ring of massive copper sulfides, molybdenite, and phlogopite mica inside the quartz shell. The pipe had a brecciated core composed of angular fragments of massive copper sulfides imbedded in a grey, finely comminuted matrix. The matrix must have had an original extreme degree of mobility in order to permit its injection under high vapor pressure into the various fractures and other zones of weakness in which it is found. A coarse, post-mineral breccia below ore grade occupies the central core. An annular-shaped stockwork of quartz and sulfide veinlets extends as a halo above the pipe's sub-surface apex and into the zone of oxidation. Secondarily enriched,



Origin of La Colorada Ore Pipe—*Formation of Post-Porphyry Subsidence Dome (Stage 2). Diagram* A *portrays renewed magma advance, retreat and renewed subsidence, and re-breaking of the pre-porphyry fracture dome. The consequent upward streaming of aqueous magmatic fluids and dissolved fluids collect under the vaulted arch at the top of the dome (Diagram* B*). The relation of porphyry and deep-seated mineralization below the dome is believed to be one of structural control.*

it is a porphyry-type copper orebody, once mined by open pit and underground methods.

As shown in Figs. 1, 2, and 3, the sequence of events in the formation of La Colorada pipe suggests interesting possibilities for additional higher grade ore. A few of the deep holes have cut short sections of breccia, mineralized with quartz, chalcopyrite and molybdenite. There is a chance that retrograde processes in the late stages of the magma cycle favored formation of one or more localized, conventional type Cananea breccia pipes in or around downward extension of La Colorada quartz porphyry.

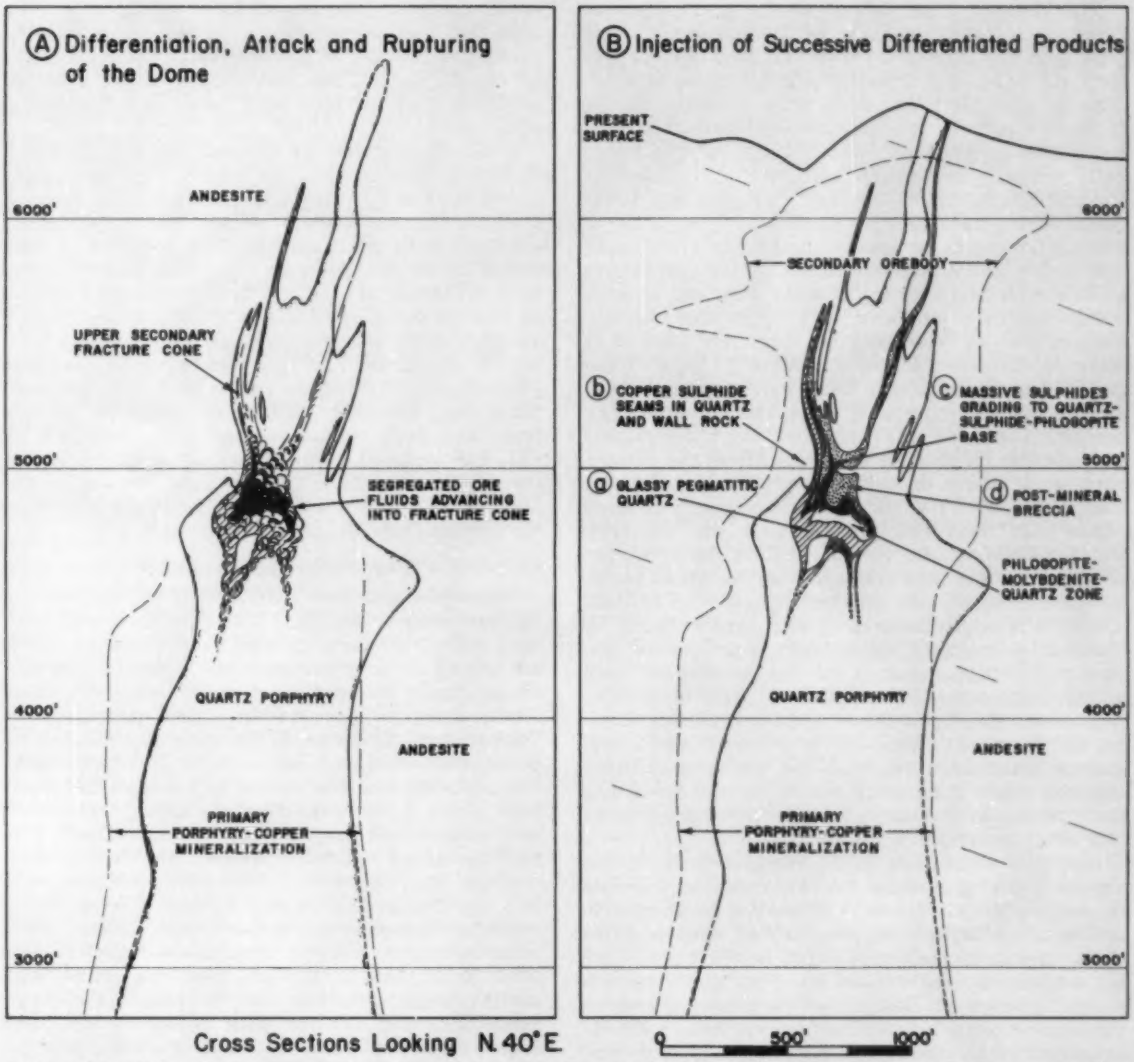
WORLD-WIDE OCCURRENCES OF MINERALIZED BRECCIA PIPES

A comprehensive summary of pipe occurrences on a world-wide basis would fill a volume and obviously is beyond the scope of this paper. Within practical limits of personal experiences and available field data, information and ideas on several kinds of ore pipes scattered over four continents are offered with reference, in particular, to mechanisms of origin related to the Cananea types.

URANIUM-BEARING PIPES OF THE COLORADO PLATEAU

No one familiar with the field relations and with the evident complexity of physical and chemical factors related to solution, transportation, and deposition of uranium minerals, would attempt any simple, all-inclusive answer to these problems. It is noteworthy that uranium-bearing breccia pipes occurring on the Plateau, have certain physical features in common with Cananea breccias and, because of the close identification of intrusive activity with the Cananea structures, they, too, may have intrusive counterparts.

The Woodrow Pipe near the Jackpile Mine on the Laguna Reservation, N. M., has been mentioned briefly by Cook and Wiley.[8] It is a vertically oriented column of brecciated sandstone and shale, circular in plan and about 35 ft in diameter. The matrix material is massive pyrite and marcasite with an unusually high-grade content of the black uranium sil-



Origin of La Colorada Ore Pipe—*Formation of Fracture Cone and High Grade Ore Pipe (Stage 3). Diagram* A *illustrates differentiation of the ore fluids, alteration, weakening and rupturing of the arch, and formation of an upward expanding fracture cone. Diagram* B *completes the sequence by showing relations between deep mineralization segregated products in the high-grade ore pipe, the post-mineral brecciation, and secondarily-enriched orebody near the present surface.*

icate, coffinite. Slumping is indicated by the drag direction of the enclosing sedimentary wall rock and by evident downward displacement of the brecciated column.

Jensen[9] has proposed that the high, variable S_{32}/S_{34} isotope ratio of the Woodrow sulfides indicates a non-hydrothermal source for the sulfur. He postulates the formation of the pipe by solution of underlying anhydrite, upward transfer of the sulfate radical, and its reduction to form sulfides. At the same time or later, the uranium, derived from an original overlying sedimentary source, migrated downward into the pipe. With due deference to the useful application of isotope ratios as a diagnostic, mineralogical tool, it is possible that processes not fully understood may modify their application under the complex physical-chemical conditions of uranium ore genesis.

As an alternate to this proposal and, since dikes and plugs of intrusive rock are characteristic of the immediate locality, this author suggests that the pipe may be related to an underlying intrusive plug, that the uranium mineralization is hydrothermal, and that the Woodrow Pipe or others like it may have been primary conduits for the extraordinary concentration of uranium in the flat sandstone beds of the Jackpile mine.

Comprehensive scientific investigations by Paul Kerr[10] and associates on uranium deposits of the Colorado Plateau lead to the conclusion that there is a genetic relationship between pipes, igneous activity and hydrothermal mineralization.

DIAMOND PIPES OF SOUTH AFRICA

No summary of breccia pipe occurrences would be complete without reference to the remarkable structures from which so many of the world's precious and industrial diamonds have come. Many ideas for their origin have been advanced by men experienced in diamond mining, and it would be presumptuous to offer more than passing comment here, based on limited personal observations and references to the literature.

The Premier Pipe, largest of the great diamond pipes, is located northeast of Johannesburg. This pipe is in the core of a felsite intrusive which may be a sill or lacolith injected into dolomites and positioned symmetrically on a nose or dome of the regional structure. It is an intensely brecciated, oval pipe, 3000-ft long and 1500-ft wide, cutting vertically through extremely hard, flinty, red felsite. Typical Kimberlite "blue mud" carrying the diamonds, varies from finely comminuted breccia along the pipe margins to coarser fragments with many rounded, cognate boulders in the center. Impressive evidence for major slump displacement can be seen inside the pipe where a very large and coarsely broken mass of Waterberg red quartzite, 1000-ft or more in diameter, forms a substantial part of the pipe filling. The quartzite block extends to the 1000-ft level of the mine and, since the corresponding formation outside the pipe has been completely eroded from its projected position above the present surface, a slump of more than 1000-ft (probably closer to 1500-ft) is indicated. Finely comminuted "blue mud" traverses the quartzite and has been injected sub-parallel to the bedding in a myriad of tongues, dikes, and dikelets. Many complex metamorphic minerals are studded through the breccia. The field relations favor early slumping followed by dynamic pulverizing, mixing and both upward and downward transportation of the brecciated rock within the confines of the pipe. As proof of upward migration, granite boulders occur within the Kimberley Diamond Pipes 500 ft or more above the granite basement. How, then, did the Premier Pipes and the other diamond pipes form, and what has their process of formation to do with the crystallization of diamonds?

Intrusive kimberlite is an integral part of the various pipes; it intrudes the "blue mud" and occurs as rounded fragments in it. Migration and redistribution of an underlying deep-seated magma could occur on a large scale and would be the basic cause for withdrawal and evacuation of a cupola beneath an embryonic pipe. Escape and transfer might occur through neighboring volcanic vents or fissure outlets by means of an interconnected magma system. The same slumping process inferred for Cananea might progress over a much greater vertical range because of the profound depth and persistent withdrawal of the magma source. The consequent column of caving rock would continue to develop upward as long as material is removed from below. Sustained action might carry the pipe development from great depth to a relatively shallow sub-surface apex. If vapor pressure builds up in the column of brecciated and invaded rock, the head of the column would become a center of intensely localized stress which, if relieved by fracturing, would provide an avenue of escape or relief to surface. Relief might be of a type similar to the process described by Walter H. Bucher[11] for development of crypto-volcanic structures. The existence of the enormous block of Waterberg quartzite that chokes the throat of the Premier Pipe suggests a mass collapse and piston-like subsidence of competent rock into a large void or vault which may have existed temporarily under a strong arch and in the near-surface zone of low rock pressure. Assuming a limited vent, rather than complete volcanic eruption and evacuation, onrushing gases, restricted by friction at the orifice, would provide a medium for violently agitating and mixing both upward and downward the pulverized and highly comminuted material filling the pipe. This matrix would surround and engulf huge blocks of heavier rock that had foundered during the slump episode. Local stratification of the brecciated material might be caused by settling and sorting of parts of the semifluid mass of "blue mud" after vapor pressures subsided.

It has been shown by General Electric scientists, including Bovenkerk[12] and others, that man-made diamonds can be created on an industrial scale at pressure ranges between 800,000 and 1,800,000 psi and temperatures between 2200° and 4400°F. A most hospitable environment for transformation of carbon to diamond would exist in a deeply extensive column of breccia reaching down to depths where hydrostatic pressure would permit the build-up and temporary confinement of tremendous vapor pressures generated by the magma and at favorable temperatures for diamond formation. Graphite derived from wall rock contamination or the reduction of CO_2 gas confined within the magma, could supply the essential carbon. Certain catalysts, as in the manufacture of synthetic diamonds, might accelerate the change from Graphite to Diamond.

COPPER PIPES IN SHIELD AREAS

Tsumeb—Southwest Africa: The district of Tsumeb is in an isolated, arid upland several hundred miles from the southwest coast of Africa. Rocks are gently dipping Precambrian sediments, including an upper feldspathic quartzite, many thousand feet of dolomite and a deeper arkosic quartzite. The Tsumeb orebody occurs in the upper dolomite which is thin bedded in part and contains limestone, shale, and tillite layers. The ore structure is on the north limb of the Tsumeb syncline and dips steeply south as a mineralized fissure zone, cutting through thin bedded, folded dolomite. Below 1900 ft, the mineralized fissure controlling the ore zone turns over to a north dip, and at that elevation, a relatively weak fracture zone called the "North Fissure" joins it in an arcuate plan to form an oval breccia pipe 500x250 ft. The oval continues downward with north plunge below the 3000-ft level and contains massive copper sulfides with shoots of lead and zinc sulfide circling the oval and extending into the breccia core. Within the oval, the bedded rocks are broken and locally well-brecciated. They are sharply faulted by the boundary fissure and appear to have been dragged and slumped downward. A most interesting feature, from a genetic viewpoint, is an isolated plug of granular quartz-orthoclase rock, locally called "pseudo-aplite", occupying at successive levels a variable but prominent position as lensy masses and irregular tongues within the oval. It is usually well mineralized and in some instances forms reticulating dikelets with angular chert and dolomite fragments and concentrations of copper sulfides at the dikelet terminations.

The oval-shaped fracture ring at Tsumeb may be an expression of underlying deep-seated collapse into a buried magma column. Contemporaneous injection of the quartz-orthoclase rock at higher levels and associated end-stage accumulation of mineralizers that circulated and deposited within the advancing breccia column, are evidence of the underlying magmatic activity. The oval ring loses its identity at the 1900-ft level, and the ore continues upward along a single fissure to the present surface.

It is an excellent example of a large fissure orebody in Precambrian sediments which, on its downward extension, develops into an important and highly mineralized breccia pipe.

Ylöjärvi Mine—Central Finland: Many other orebodies in shield areas show evidence of mineralized breccia pipe development. In the deep-seated metamorphosed volcanics and schist of central Finland, the Ylöjärvi copper orebody is confined to a well-defined breccia pipe. The deep-seated character of the brecciation is testified to by the scarcity of vugs and voids and the manner in which superimposed schistosity and flowage lines modify and deform individual tongues and bands of breccia.

It seems probable that on the Canadian Shield, breccia pipes are more numerous than has generally been recorded. Breccias are commonly observed in many of the great mines of eastern Canada and correlation of such features, though difficult because of the complex nature of deformation and metamorphism, may reveal important additional structural elements.

PORPHYRY COPPERS OF SOUTH AMERICA

One of the great copper belts of the world extends along the rising westerly slope of the Andes from Peru into the central part of Chile. Within it and forming a primary structural part of several of its important orebodies, are outstanding examples of mineralized breccia pipes. Several of the most important occurrences are discussed below.

Toquepala, Peru: The great orebody at Toquepala is a widespread blanket-like deposit of enriched chalcocite ore with a central core of deep-seated primary copper sulfide mineralization. It is an excellent illustration of the coincidence of a succession of geologic events centered around a migrating vertical axis of deformation and stress.

An overall concentric pattern is accentuated by the arcuate strike of several dacite porphyry dikes which are associated both in time and space with copper mineralization. Following intrusion of the porphyry, there is a succession of semi-circular pipes with their centers progressively shifting from south to north, each younger one overlapping, biting into and cutting out its next oldest neighbor. First, at the southerly edge of the deposit, there is a stockwork of pegmatitic, glassy quartz veinlets. Copper mineralization occurs sparingly within the quartz and is concentrated along later sulfide veinlets and in abundant disseminations through the shattered rock. Second, there is a large, circular, mineralized breccia pipe composed of dacite porphyry and quartz diorite fragments in a matrix of quartz and copper sulfides. L. H. Hart[13] has commented that since the fragmented rocks appear to match up fairly well with their wall rock co-relatives, no important displacement either upward or downward is indicated. It is this author's observation that, since the rock contacts here are steep or vertical, there is no adequate marker to determine vertical displacement within the pipe's interior, but that the similarity in appearance between the Toquepala breccia and that of many proved collapse breccias, argues strongly in favor of a major slump process.

Richard and Courtwright[14] describe occasional anomalous field relations, such as "ore breccia" included in dacite porphyry and barren "pebble breccia", as fragments in the mineralized breccia, indicating repetition of events and complexity of relationships that usually characterize important centers of breccia pipe development. In any event, a large and important area of post-mineral brecciation composed of a finely pulverized matrix of rock and sulfides, including and surrounding a variety of coarse, angular to rounded fragments, intrudes and cuts out the north central part of the mineralized breccia pipe. From the appearance of this material, it may be inferred that it was agitated and mixed under extreme gas pressures and injected as tongues and seams into available planes and zones of weakness. The post-mineral breccia cuts out the north part of the mineralized breccia pipe, and its relation to mineralization is similar to that of Cananea's post-mineral types.

A late chapter in the sequence is represented by a large, circular area of so-called "dacite agglomerate" with steep contacts, which takes a crescent-shaped bite out of the northern edge of both the mineralized pipe and the second-stage post-mineral breccia. This latest or third stage of brecciation contains abundant fragments of dacite porphyry in a finely pulverized matrix. It has wiped out all vestiges of sulfide-bearing breccia, removing the original rock, and replacing it with finely ground foreign material. As the final phase of magmatic activity, small bodies of latite porphyry intrude the "dacite agglomerate."

The many chapters of the Toquepala story add up to a complex sequence of events around a northerly migrating deep, vertical axis which localized successive phases of intrusion, brecciation, mineralization, post-mineral brecciation, and final end-stage intrusive activity.

Braden, Chile: The Braden orebody is well known. The similarity between Braden and Toquepala has been discussed recently by F. H. Howell and J. S. Molloy[15] who show that both deposits have circular patterns of intrusives, alteration, mineralization, and structural elements which suggest similar processes of origin. The crescentic-shaped plan of Teniente orebody at Braden embraces a stockwork fracture zone principally in andesite, which has been biotized and highly mineralized with interlacing seams of quartz, copper sulfides, and molybdenite. Along its inside or westerly edge, there are occurrences of well-brecciated rock with a mineral matrix of tourmaline and copper sulfides. The ratio of mineralized stock work to mineralized breccia is much greater at Braden than at Toquepala, but relative positions and evidence of timing indicate their similar modes of origin.

Braden, too, has conspicuous post-mineral breccia which cuts out both stockwork and mineral breccia elements, as it does at Toquepala. There, the central axis of intrusion, fracturing, brecciation, mineralization, and post-mineral deformation moved progressively with each successive event to the north, thus forming an overall asymmetric pattern, while at Braden the axis remained fixed, producing a symmetrical, concentrically repeated pattern of all the structural elements in the Braden sequence. The intense brecciation of the "Braden Pipe," coming at the closing stage of mineralizing activity, correlates with the typical late gas phase represented by violent churning and fragmentation within the confines of the pipe. Such action corresponds to post-mineral brecciation at Cananea, Toquepala, and other breccia pipe localities. Bedding, observed locally in the Braden post-mineral breccia, may have been induced by the final settling, sizing, and stratification of the semi-fluid mass within the pipe after vapor pressures had subsided.

El Salvador, Chile: The new orebody at El Salvador has many of the structural features, rock and mineral characteristics of other porphyry coppers, including Toquepala and Braden. It has been well

described by William Swayne and Frank Trask[16] who portray the great horizontal extent of its mushroom-shaped ore outline within a diverse pattern of rock types. The shape of the ore is accentuated by secondary enrichment although there is notable evidence that primary copper sulfides, confined initially to a central, vertical axis, also spread along flat, selectively fractured andesite beds and under a warped and domed rhyolite cap to give the ore body its mushroom-like shape. The rock and mineralization patterns indicate that a large, composite, overlapping series of circular fracture zones resulting from domical subsidence localized the mineralizing process at El Salvador.

Practically all the ore developed to date is confined to stockwork fracturing, although both mineralized and post-mineral breccia sections have been exposed in the central columnar stem of the orebody. The mineralized breccia has the pegmatitic appearance of Cananea's East Breccia type; the post-mineral structure contains small, angular fragments of high grade chalcopyrite-bornite in a clay matrix. These occurrences could be part of a deep-seated primary breccia conduit which controlled one stage of the rich flood of copper-bearing fluids responsible for the orebody.

SUMMARY AND CONCLUSIONS

The widespread occurrence and close relation of breccia pipes to many great orebodies give them unusual importance. They are chimney-like masses of brecciated rock, circular, oval or polygonal in plan outline, with steep axes proportionately much greater than their horizontal dimensions. Impressive downward displacement or slumping of identifiable rock fragments and the development of characteristic void spaces within the breccia columns are evidence for removal of large volumes of the original rock. Since the tops of many pipes are covered and sealed by unbroken roofs, the evidence is conclusive that removal of material must have occurred from below. Rock in the breccia chimneys may be broken by the removal of underlying support at the active summits of fluid magma columns. Pressure readjustment and magma withdrawal would result from developing disequilibrium, caused by volcanic or fissure eruption in a neighboring part of the system. Thus, advancing, localized subsidence may be a fundamental response, in a reciprocal sense, to repeated spasms of dying volcanism. A corollary of the process is the creation of foci of reduced pressure within growing breccia chimneys and the consequent localization of end-stage, mineral-rich vapor and liquid phases, distilled from the crystallizing magma and attracted to these broken low pressure zones in the rock.

The significance of mineralized breccia pipes is that they are climactic expressions of general processes which, under differing local conditions, may also form the ring or dome-shaped fracture zones that control certain porphyry copper deposits. Thus, they provide clues to the origin of many of the world's great orebodies, including Anaconda's La Colorada mine at Cananea, Mexico, and the new El Salvador mine in Chile. Analysis and understanding of these and similar structures may help to solve problems of scientific and economic importance related to processes controlling the collection, circulation and deposition of mineralizing fluids.

ACKNOWLEDGMENTS

My first introduction to the interesting geology of breccia pipes occurred soon after the discovery of La Colorada orebody in Cananea, Mexico. For the next nine years under the general direction of Reno H. Sales, and assisted by Roland Mulchay, I had an unusual opportunity to observe and record the geology of the district. I am deeply indebted to these men and to many other geologists of The Anaconda Co., including Glenn Waterman, William Swayne, Charles Meyer, Ruben Velasco, and Paul Lindberg for their valued assistance in the preparation of this paper.

Remarks on a subject of such broad scope must inevitably include a composite of thoughts and ideas of others. I appreciate the important and constructive help of the many geologists who have contributed to the literature of breccia pipes. Credit has been given to many of these men and their ideas on the preceding pages, but I necessarily accept the responsibility for my own interpretations.

Acknowledgments are due also to the Anglo-American Corp. and Darell Hallam, Geologist of that Company, for the opportunity to visit the Premier mine in South Africa. Similarly, I am indebted to P. G. Sohnge and the Newmont Mining Corp. for showing me the geology of the Tsumeb properties in Southwest Africa several years ago, and to P. Haapala, Chief Geologist of the Outokumpu Co., under whose guidance I visited the Ylöjärvi mine in Finland after the 1960 International Geological Congress at Copenhagen, Denmark.

Through the courtesy of American Smelting and Refining Co., I had the opportunity a few years ago to visit Toquepala, Peru, in company with their Chief Geologist, Lyman O. Hart. Hart's assistance in the field, together with that received from publications by him and by two other Asarco geologists, K. Richard and J. H. Courtwright, are acknowledged with gratitude. Of equal importance, I am indebted to the Kennecott Copper Corp. for affording me the opportunity of visiting their famous Braden mine in Chile several years ago.

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UNDERGROUND USE OF AMMONIUM NITRATE - FUEL OIL EXPLOSIVES

Experimentation with ammonium nitrate-fuel oil mixtures at three underground salt mines revealed its excellent applications at those properties. The author relates the present blasting practice used at these mines by the International Salt Co.

by JOHN L. RYON, JR.

The International Salt Company is presently performing blasting operations with a pneumatically-placed ammonium nitrate-fuel oil mixture at three rock salt mines, and plans its use in the near future at its new Cleveland mine. Use of ammonium nitrate is saving the company approximately $250,000 annually. With rapidly increasing operating expenses and increasing competitive pressure resulting in lower prices, savings such as those realized through the use of ammonium nitrate are vitally important.

ORIGINAL INVESTIGATION AND EXPERIMENTAL ACTIVITIES

The three mines presently involved are located at Detroit, Mich.; Avery Island, La.; and Retsof, N. Y. Initial experiments were conducted at the Detroit mine where a detailed investigation was carried on to determine the significance of the static electricity factor when blowing ammonium nitrate into drill holes in which millisecond delay electric blasting caps had been placed.

Although the information developed at the Detroit mine was passed along to the other mines, each mine independently pursued its own course of investigation. This fact, plus the differing mining conditions, resulted in slightly different operational procedures at each mine. Some of the varying statistical data are shown in Table I, and data common to all three International Salt Company mines are shown in Table II.

J. L. RYON, JR., Member of SME, is Assistant Director of Production, International Salt Co., Clarks Summit, Pa.

BLASTING PROCEDURE AT THE DETROIT MINE

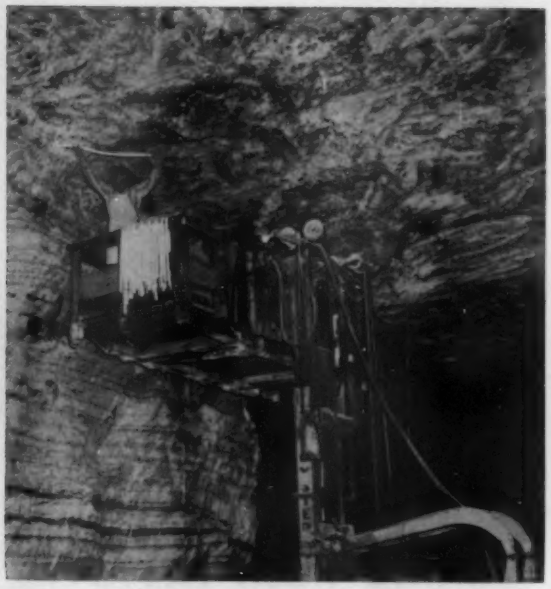
This mine has been using the ammonium nitrate-fuel oil mixture for more than two years on a full time production basis and represents the successful detonation of several hundred thousand holes. Results have been excellent and the blasting cost has been reduced many times.

Table I

	Detroit	Retsof	Avery
Drill hole diam	2¼ in.	1⅞ in.	1⅞ in.
Room size (width × height)	50 × 34 ft	65 × 9½ ft	100 × 86 ft[1]
Drill holes per face	57	52	187-227[2]
Tons per room advance	900	425	6600
Approx. pct by weight dynamite primer of AN	4	9.7	10
Stemming	No	Yes	No
Location of dynamite primer in hole	Bottom	Collar	Bottom
Drill cuttings blown from drill holes	No	Yes	No
Commencement of AN/FO blasting on full-time basis	October 1958	July 1960	May 1960

[1] Two benches: bottom bench, 34-ft high; top bench, 52-ft high.
[2] Two benches: bottom bench, 187 holes; top bench, 227 holes.

Filling polyethylene tubes with AN at the Detroit mine.



Placing AN-filled tubes in top holes in the Detroit mine.

The actual operation at Detroit consists of adding the fuel oil to the bags of ammonium nitrate by means of a portable fuel oil tank complete with hose, nozzle, and metering device. The bags of the ammonium nitrate-fuel oil mixture are transported to the working face from the oiling area by means of a jeep-drawn trailer. At the face, the ammonium nitrate is placed on the elevating platform of a powder-loading rig which consists of a pneumatically-tired, large fork-lift truck with a fully insulated elevating platform constructed on the forks.

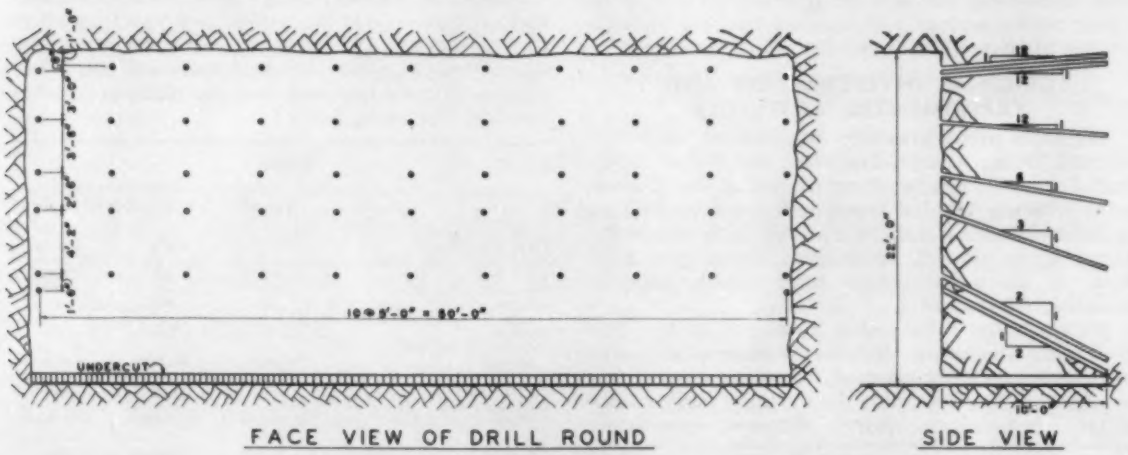
Table II

Depth of drill hole	11 to 14 ft
Advance per cut	10 ft
Pct fuel oil to AN	6
Blasting caps used	electric millisecond delay
Size of dynamite primer cartridge	1¼ × 8 in.
AN placement method	Pneumatic
AN type	Prilled-uncoated
Dynamite primer	High velocity gelatin
Wt, solid rock salt	135 lb per cu ft
Wt, graded rock salt	75 lb per cu ft

The placement of the dynamite primer and the pneumatic placement of the ammonium nitrate is a two-man operation. First, one cartridge of the primer is placed in each hole on the line of holes which can be reached from the loading rig platform. The plastic hose is then inserted into the hole and pushes the primer to the back of the hole. The proper charge of ammonium nitrate is then placed in the pneumatic placement machine and, upon signal from the operator, blown into the hole. Leg wires are subsequently connected and the face is ready for detonation.

Numerous tests were conducted to determine the presence or extent of static electricity as ammonium nitrate was being blown into drill holes and after it was in place in the drill holes. Without exception, there has never been any measurable amount of static voltage found on the ammonium nitrate-fuel oil mixture in the drill holes in the Detroit mine.

It was discovered early in the experimental period that, when detonated, the ammonium nitrate-fuel oil mixture in the top row of blast holes produced an excessive shock which apparently weakened a sand



Face drilling pattern employed at the Detroit mine.

seam about one foot above the mine roof. After a week or more, this weakened seam allowed the one foot slab, or scale, of salt roof (about three to four feet of salt are left on the roof for support) to sag and eventually fall. Obviously, this condition was hazardous and, therefore, some new technique had to be developed for shooting the top row of holes. The technique which has evolved consists of using long polyethylene tubing 1¼ in. in diameter by .005 in. thick, filled with the ammonium nitrate-fuel oil mixture. These tubes, which are bought in rolls of 50 ft, are cut to 4-ft lengths and filled with ammonium nitrate by using a special piece of equipment. Both ends of the tube are closed by stapling. In loading the top row, the primer is first placed in the hole; then the tube is inserted into the hole. The collar end of the tube is punctured to provide expansion in the collar end of the hole by light tamping. No stemming is used. This procedure provides an air space between the 1¼ in.-diam tube and the 2¼-in. hole. This air space tends to cushion the shock upon detonation. The scale problem has been completely solved by using this procedure. As this polyethylene tube idea developed, there was some concern that the air space in the drill holes might give trouble in the form of incomplete detonation or misfired holes. However, there has been no trouble of this sort encountered to date.

At the Detroit mine the entire year's supply of ammonium nitrate is purchased during the summer when the price hits the seasonal low. The material which is purchased in 50-lb polyethylene bags is stored in the mine at various locations. Humidity and temperature being almost constant, the mine provides excellent storage conditions, and virtually no caking of the ammonium nitrate occurs.

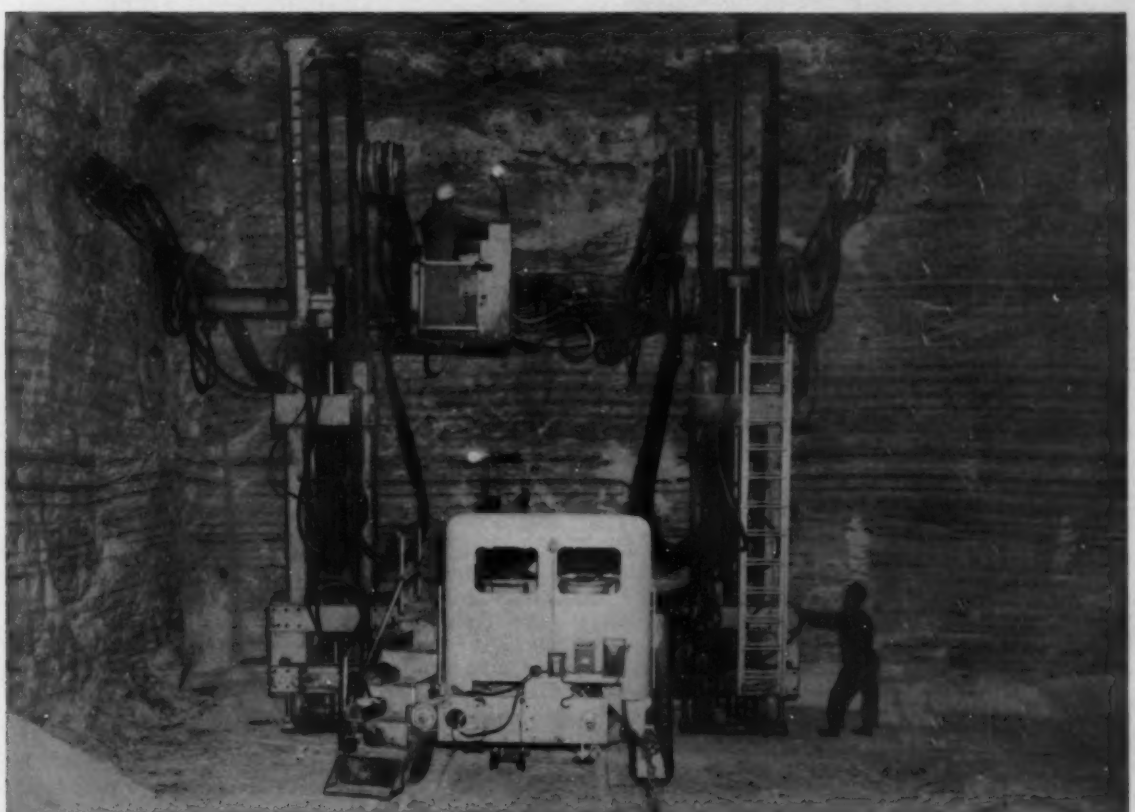
RETSOF MINE

In 1959, the company investigated the possibility of using the ammonium nitrate-fuel oil mixture underground in the Retsof mine. Ammonium nitrate was first placed in kraft-paper tamping bags and after encouraging results were obtained, a pneumatic placement machine was purchased and holes were successfully loaded on an experimental basis. Both U. S. Bureau of Mines and New York Department of Labor representatives were present for portions of the experiment.

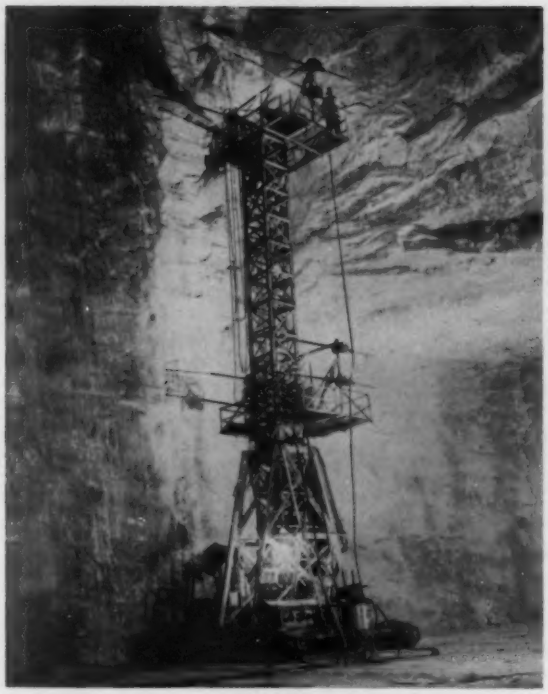
It was found that, with the smaller diameter holes at Retsof and their practice of collar priming, the amount of oxides of nitrogen could be reduced by blowing drill cuttings from the drill holes with an air hose after the entire room has been drilled. However, Retsof is presently investigating the possibility of blowing the cuttings from the holes by using a drill auger with an air hole provided in its center. This would permit the blowing out of the cuttings as the hole is being drilled.

Early in 1960, Retsof put into use an ammonium nitrate loading rig consisting of a diesel-powered jeep and trailer. A 60 cfm air compressor and 50-ft reel of air hose is mounted on the jeep, and the trailer holds the pneumatic placement machine and one day's supply of ammonium nitrate in bags.

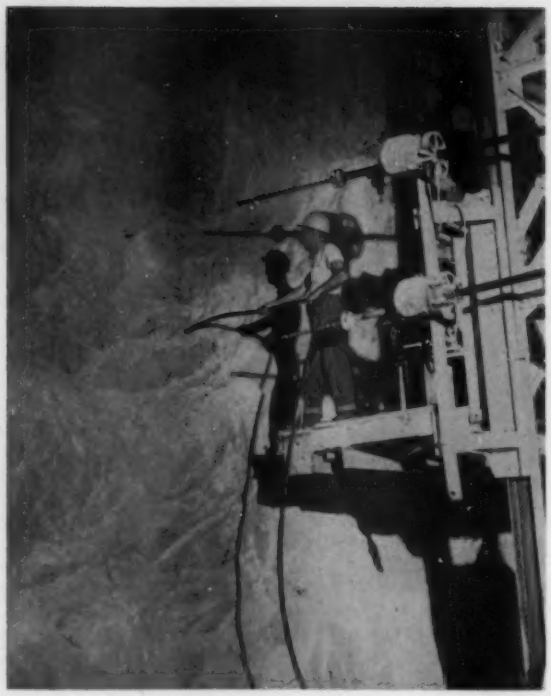
The present actual sequence of the powder-loading operation consists of blowing cuttings from the drill holes, blowing in the ammonium nitrate-fuel oil mixture, placing the primer in the hole, placing the tamping bags in the hole, and connecting up the cap leg wires. A two-man crew can complete five rooms in one eight-hour shift.



Detroit mine drill rig.



Self-propelled telescoping masted drill rig at Avery Island.



Pneumatic emplacement of AN-FO at Avery Island.

As at Detroit, all blasting is done at the end of the last shift (afternoon shift). After blasting, each section foreman measures the rooms for nitrogen dioxide content. The maximum allowable concentration of this gas is five ppm. The readings taken are consistently well below this level.

AVERY ISLAND MINE

The Avery Island mine, which mines about one-half million tons of rock salt per year, began experimenting with the use of ammonium nitrate-fuel oil mixtures in 1959 and started using this material for blasting on a full time basis in May 1960.

Early experimentation at this location also consisted of loading holes with kraft-paper tamping bags filled with ammonium nitrate. Blasting was tried with and without stemming, but results were not satisfactory. However, with the knowledge of the successful application of ammonium nitrate blasting at the Detroit mine, the Avery mine purchased a pneumatic-placement machine which gave very satisfactory results.

At Avery, the entries are driven in two benches. The first advance (or lower) bench, 34-ft high, 10-ft deep, and 100-ft wide, is undercut and drilled with a self-propelled cat-mounted multiple drill rig. The second bench, 52-ft high, 14-ft deep, and 100-ft wide is drilled with a telescoping mast rig. This benching practice produces a face 86-ft high and 100-ft wide. In the interest of efficiency, the benches are shot at the same time whenever possible. Obviously, this cannot always be done since the low roof advance is 10 ft and the high roof advance is 14 ft.

The drilling, loading, and shooting crew consists of three men. One man handles the pneumatic placement machine and charges this machine at ground level, and two men are located on the elevating platform of the drill rig to handle the loading hose and to prime the holes with dynamite. One of the men on the rig places the primer in the back of the hole; the second man handles the plastic hose for blowing the ammonium nitrate into the holes. He is guided by markings on the hose as to the amount of ammonium nitrate going into the holes. Pressures used vary between 25 and 40 psi, depending on the height of the drill hole being loaded. While the loader is placing the ammonium nitrate in the hole, the second man is placing the primer in the next hole. When all holes have been loaded, the cap leg wires are connected and the room is ready to be shot.

At each of the three mines, fuel oil is added to the ammonium nitrate in the bag. There is no mechanical mixing of the ammonium nitrate-fuel oil, but the polyethylene bags are allowed to stand from 24 to 48 hours for soaking time. There has never been any indication of improper distribution of the fuel oil through the ammonium nitrate, and regular checks are made to determine the presence and amount of oxides of nitrogen. Without exception, concentrations are found to be well within allowable limits. Fragmentation of the salt is excellent. It is the opinion at each mine that, pound for pound, the ammonium nitrate-fuel oil mixture gives at least an equivalent performance as that of dynamite.

SUMMARY

The International Salt Company is presently performing its blasting operations more efficiently and effectively than ever before. Results at all mines are at least equal, and in most respects superior, to the blasting results obtained while using the more conventional materials and procedures. It is significant to observe that, although each of the three mines conducted its own investigation and experimentation on this matter, each concluded that the use of the ammonium nitrate-fuel oil mixtures for blasting is more desirable than blasting accomplished through the use of dynamite.

REPORT ON ACTIVITIES

OF

ENGINEERS JOINT COUNCIL

A summary of 1960 EJC activities during the past year was provided at the last meeting of the EJC Board of Directors on January 19, 1961. Dr. A. B. Cummins, Past-President of SME, and AIME Representative to the EJC Board, reported that:

The Engineering Manpower Commission has completed its 1960 Survey on Earnings of Engineers. The report was made public in February 1961.

American Society of Testing Materials was voted an Affiliate member of the EJC.

American Society of Agricultural Engineers transferred from Affiliate to status of Constituent Society.

Consulting Engineers Council applied for transfer from Regional Associate to National Associate. Denied on technical grounds.

The Engineering Research Committee has attempted to define its activities pertaining to major technical problems of the next 5 to 25 years. Twelve sub-committees have been organized because of the complexity of the problems. An ambitious program for this committee is indicated, but it has not been developed and it will be a year before definite goals may be established.

Organization of the work pertaining to the National Academy of Engineering has been started. One objective is to establish whether such an organization is needed and how it will function. One of its major values will be in providing engineers to help solve problems related to the national need.

A report has been prepared on "Professional Liability and Responsibility," which will require action by the Boards of EJC and the American Institute of Architects (AIA). This report is revised, on advice of counsel, for some condensation or modification. In its present form this report pertains mostly to the relationships of the design professions. Copies of the complete report are available to all participating Societies for information.

EJC sponsored a mission to the USSR in the early fall of 1960. Its main purpose was to "study the current utilization and educational practices relative to engineers and engineering technicians." A complete report is being prepared for publication and general distribution.

The EJC publication, *Engineer* has survived its first year and seems to be serving a useful purpose. It has the largest circulation of any engineering publication in the U.S. In 1961 the *Engineer* will carry advertising to partly defray expenses, but assurance has been given that there will be no competitive angles with the technical advertising of the Journals in EJC Societies.

The Joint Committee of ECPD-EJC Amalgamation has recommended amalgamation of the two organizations. Action by the two Societies has not yet been taken.

EJC Officers for 1961

1) President: *J. N. Landis* (ASME) replacing *A. B. Kinzel* (AIME)
2) AIME Representatives on EJC Executive Committee: *A. B. Kinzel*
   W. R. Hibbard, Jr. (alternate)
3) AIME Representatives on EJC Board of Directors:

J. L. Gillson, Ex-Officio	Alternates:
J. S. Bell	*T. B. Counselman*
A. B. Cummins	*J. B. Hammond*
W. R. Hibbard, Jr.	*Paul Queneau*

AIME Representatives on EJC Committees

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Engineering Manpower Commission: *J. W. Feiss*
Finance: *J. S. Vanick*
International Relations: *R. F. Cramer, F. T. Agthe, D. Nix*
Membership: *F. D. Day*
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Public Relations: *F. E. Loeffler*
Government Liaison: *W. J. Harris, Jr.*
Who's Who in Engineering: *E. H. Robie*
Secretaries: *E. O. Kirkendall*
Nuclear Congress: *A. B. Kinzel*
Engineer Editorial Advisory: *H. M. Jacob.*
Computer Applications: *P. C. Hilty*
Technical Planning: *J. L. Gillson*
National Academy of Engineering: *W. R. Hibbard, Jr.* (Chairman)
National Water Policy Panel: *Shirley Lynch* (*Parker Trask*, Alt.)
ECPD-EJC Amalgamation: *A. B. Kinzel*, Co-chairman representing EJC

USE OF DATA PROCESSING MACHINES FOR CALCULATING ORE RESERVES AT THE SULLIVAN MINE

by

A. C. FREEZE

The first use of electric punched card accounting machines as an aid in calculating reserves at the Sullivan mine in Kimberly, B.C., was made in January, 1948. At that time their use was limited to totalling individual reserve blocks for the various reserve classes and for calculating total metal content. The immediate objective was to increase speed, improve accuracy, and to effect some savings in labor that could be employed more usefully elsewhere. It was recognized also that the potential for achieving even greater advantages was excellent.

The initial experiment proved so successful that it was inevitable that the use of the method would expand. Thus, for the past nine years assay data from core hole and development headings have been processed by these machines and the results integrated with the program of calculating reserves. It was also learned that the machines could store and classify a large amount of other information concerning the mining characteristics of each reserve block in addition to tonnage and metal content. This has proven very useful for the preparation of monthly production reports as well as in long term planning, in forecasting production schedules, and in analysing the results achieved.

GEOLOGY OF THE SULLIVAN MINE

The orebody is considered to be a bedded replacement deposit in which a certain sequence of interbedded argillites and argillaceous siltstones of late Precambrian age have been replaced by pyrrhotite, sphalerite, galena, and pyrite. Small quantities of other minerals are present, but of these, only cassiterite will be mentioned. The main ore lens is thick, rudely tabular in shape, but slightly deformed. The deposit has been developed over a strike length of about 5,000 ft and for about the same distance along the dip.

The ore in the central part of the main lens is essentially all sulfide but the proportion of the principal sulfide minerals varies greatly from place to place. In contrast to this, the ore in the outer zone of the deposit consists largely of interbands of argillaceous sediments and finely banded sulfides. The grade and thickness of these ore bands can vary widely within this zone, making the use of length as an unmodified factor in calculating average grade liable to large errors. On account of this, in calculating sample length, average grade is modified by the inclusion of a factor for specific gravity. This became practicable only through the use of the machines described below.

PILLAR MINING STIMULATES USE OF DATA PROCESSING SYSTEM

Large scale underground mining had been carried on at the Sullivan mine for about 25 years, through a major economic depression and World War II. A large part of the unmined ore was in pillars which varied widely in form and dimensions. Some were contained by fill derived from the surface; others would be contained by a cemented aggregate derived from the float fraction from the sink-float plant; still others would have to be extracted without containment or support for the adjacent stope backs. Large tonnages of mineralized material with a metal content that was too low to be mined profitably in times of low prices laid in the bottoms of many stopes and often covered with fill.

As a matter of policy, the Sullivan mine was expected to provide the Company's plant at Trail, B. C.,

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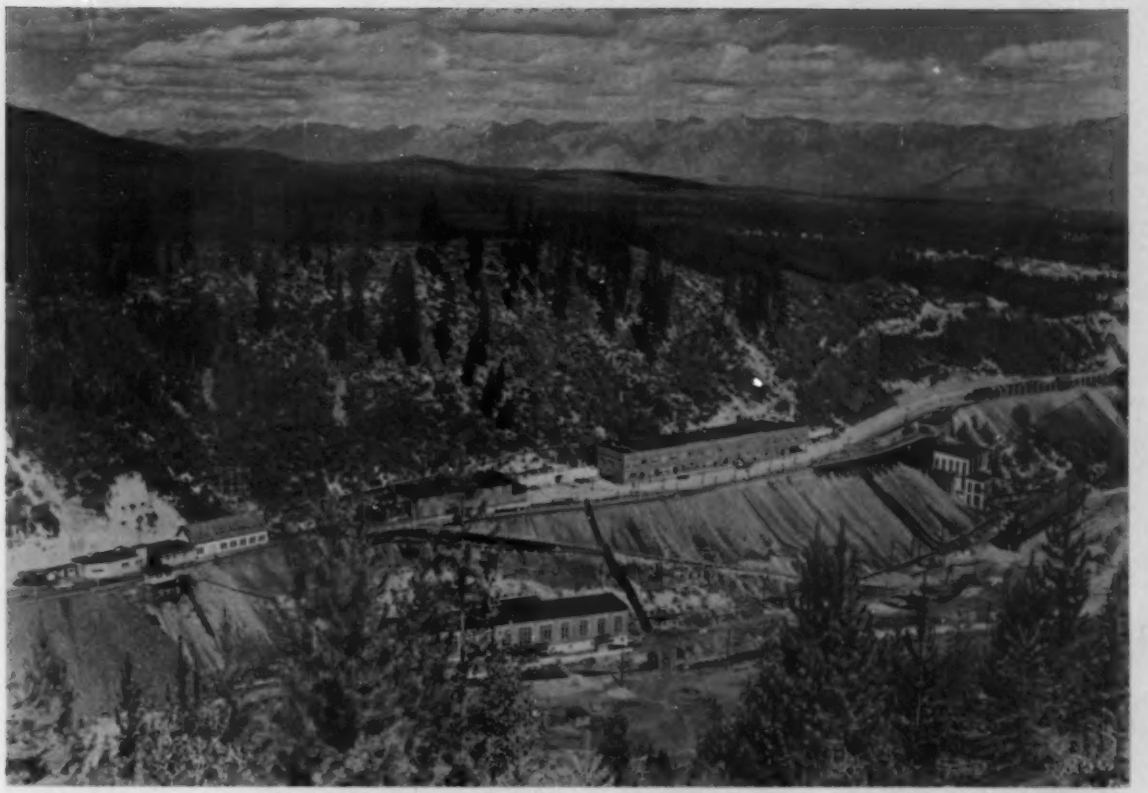


Looking east at a part of the Surface Plant of the Sullivan Mine with the Rocky Mountains in the background.

with an adequate tonnage of suitable concentrates for many years to come, and to insure this, it was necessary to devise a "Long Range Mining Plan." The plan adopted was based essentially on mining a maximum of pillar ore without creating a serious risk of damaging the remaining ore by sudden transfers of stress. All other factors relating to maximum economic extraction were to be integrated with this central objective insofar as it was feasible to do so. The plan would be reviewed and revised every five years to bring it into line with knowledge gained through experience.

In attempting to forecast and execute production schedules within the frame work of this plan and in trying to analyse the results achieved, many mining engineers and geologists were soon working with a tremendous amount of data that were largely unclassified and very unwieldy to deal with manually. Attention was directed naturally to the possibilities of using the accounting machines for this work along with the calculation of reserves. This objective was finally achieved after about three years of study, experimentation, and some revision of equipment.

The IBM electrical accounting machines being used in the accounting department at Kimberly, and their functions are:

1) Three key punches: used to punch the basic data manually on key-punch cards.

2) One verifier: signals lack of correspondence in the information punched by the key punch operator and the checking operator.

3) Two sorters: sorts cards into the desired sequences.

4) One calculating punch: multiplies, divides, adds, subtracts, stores information, and punches information on cards. It is the key instrument in this data process; versatility rather than speed is its outstanding characteristic.

5) One collater: merges, selects, and matches cards according to the sorting sequence desired. About its only use in calculating reserves is to eject obsolete cards and merge the revised ones into the card deck.

6) One summary gang punch and one reproducing punch: used to make new decks of cards from old decks. In addition, they are capable of adding or deleting information as required.

7) One interpreter: records on top of card, alphabetically or numerically, the information represented by the punches. It facilitates visual checking or selecting when necessary.

8) Two tabulators: basically printing machines that will produce printed reports either alphabetically or numerically. These units can add or subtract, and by means of a system of selectors, can pick out and list information that is wanted from the master cards in any such grouping that might be required.

PROCESSING CORE HOLE ASSAYS

The processing of assays from a diamond drill core provides the simplest and clearest illustration of the various data processing machines. Samples of mineralized core are routinely assayed for silver, lead, zinc, and soluble iron. The assays are recorded by hand on the diamond drill record (Fig. 1), and the sheets are then sent to the mining geologists who manually fill in the following columns on the sheet: "spacer footage," "lithology," "footage from—to,"

(Text continued on page 388)

SEQUENCE OF DATA PROCESSING RECORDS AT THE SULLIVAN MINE

THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED

DIAMOND DRILL SAMPLING RECORD

Footage From	Footage To	Spacer Footage At	Spacer Footage At	Litho-logy	Shorts Feet	Sample No.	ANALYSIS Ozs. Ag.	% Pb	% Zn	% Fe
0.0	38.2	38.2	38.2		3.2					
38.2	43.5					42811	0.1	0.2	0.3	8.8
43.5	46.5			D Sulf	0.3	42812	0.1	2.6	9.6	14.6
46.5	54.8					42813	0.1	0.2	0.3	5.0
54.8	145.0	54.8	54.8							
		145.0	145.0							

Started: NOV. 18, 1960. Finished: NOV. 24, 1960. Plane: 2851 X.C.E. Dip: -70° Geol. Sec. 15 X.E. Length: 145' Keep: ✓ Discard: Hole No. 5567 Sheet No. 1 Core Size AX

Fig. 1

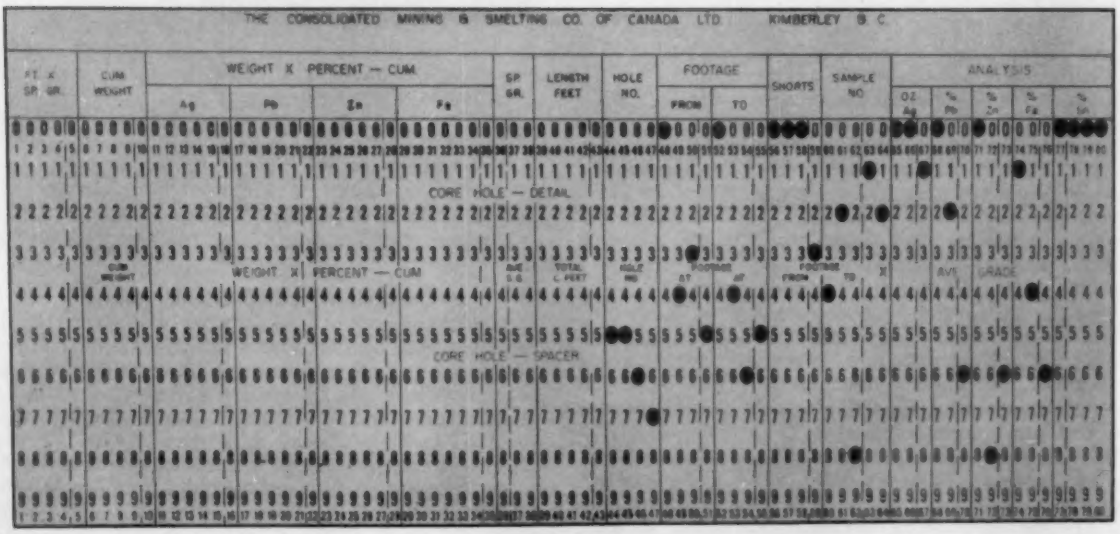


Fig. 2

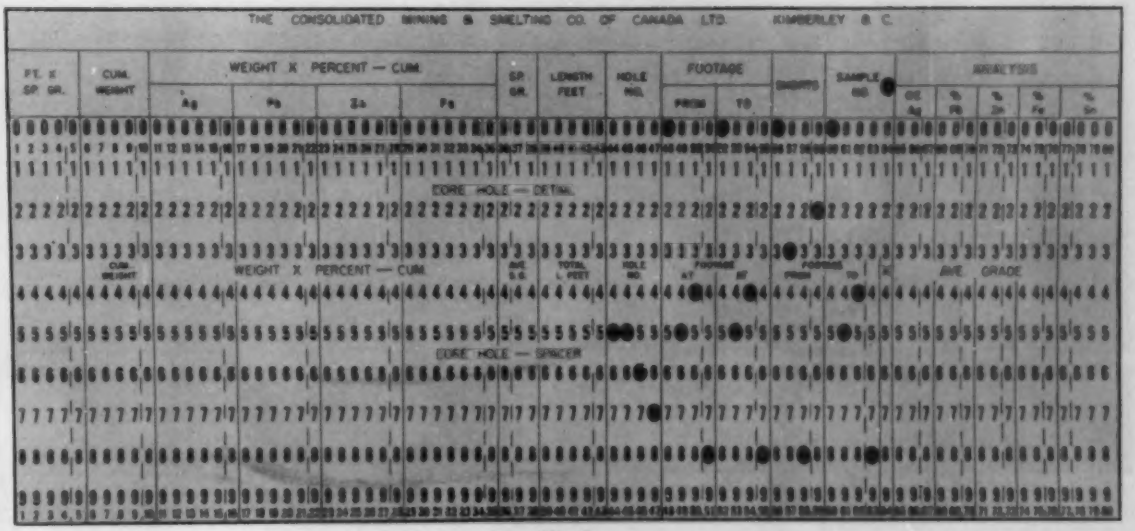


Fig. 3

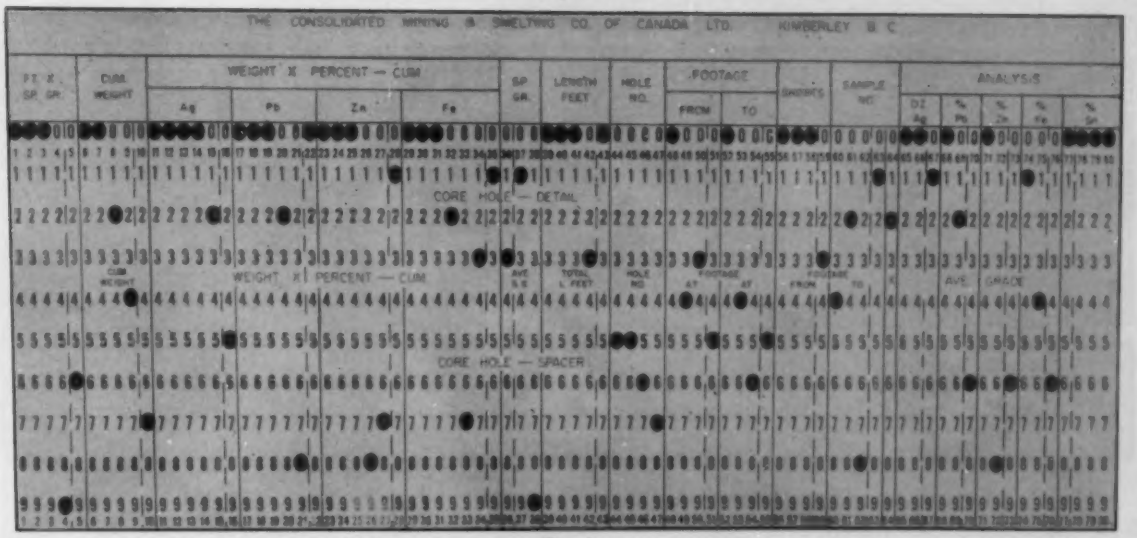


Fig. 4

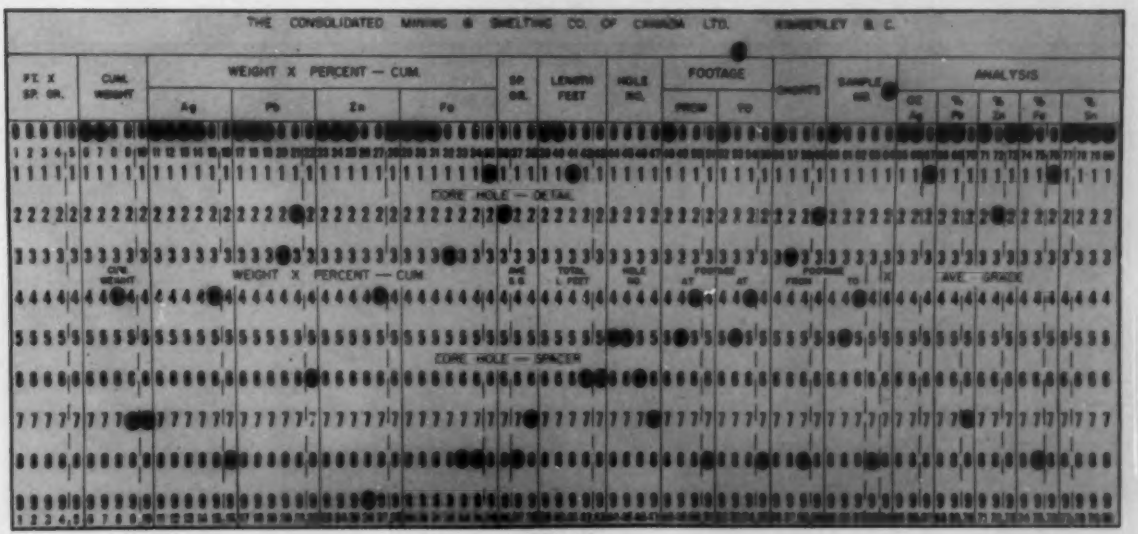
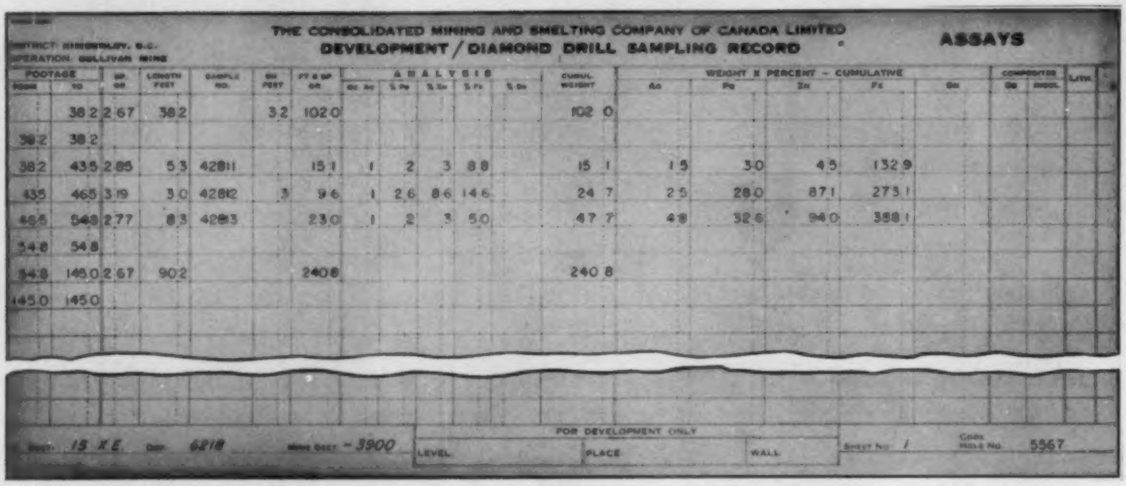


Fig. 5



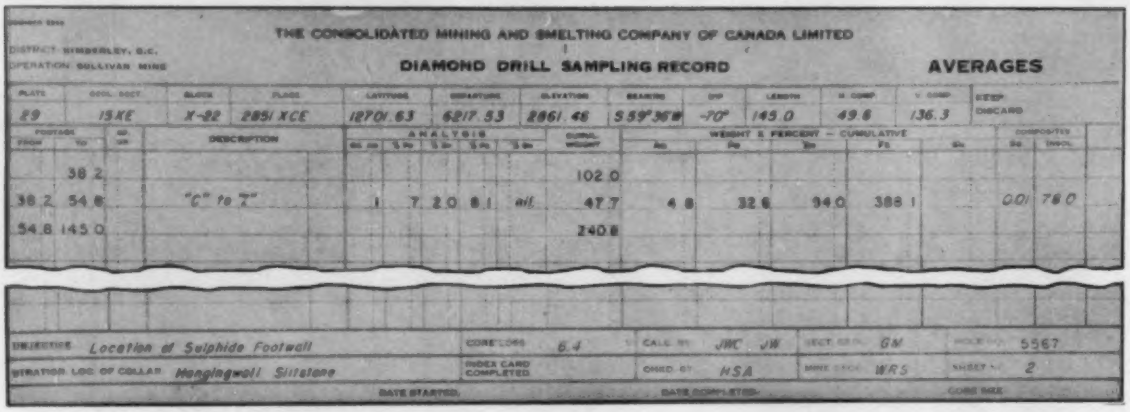
THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED
DEVELOPMENT / DIAMOND DRILL SAMPLING RECORD — ASSAYS

DISTRICT: KIMBERLEY, B.C.
OPERATION: SULLIVAN MINE

Footage From	Footage To	SP GR	Length Feet	Sample No.	SH Feet	FT x SP GR	Analysis Oz Ag	% Pb	% Zn	% Fe	% Sn	Cumul. Weight	Weight x Percent – Cumulative Ag	Pb	Zn	Fe	Sn	Composites		Lith
	38.2	2.67	38.2		3.2	102.0						102.0								
38.2	38.2																			
38.2	43.5	2.85	5.3	42811		15.1	1	2	3	8.8		15.1	1.5	3.0	4.5	132.9				
43.5	46.5	3.19	3.0	42812	3	9.6	1	2.6	8.6	14.6		24.7	2.5	28.0	87.1	273.1				
46.5	54.8	2.77	8.3	42813		23.0	1	2	3	5.0		47.7	4.8	32.6	94.0	388.1				
54.8	54.8																			
54.8	145.0	2.67	90.2			240.8						240.8								
145.0	145.0																			

SECT. 15 XE DEP. 6218 MINE SECT. −3900 FOR DEVELOPMENT ONLY: LEVEL, PLACE, WALL SHEET No. 1 CODE HOLE No. 5567

Fig. 6



THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED
DIAMOND DRILL SAMPLING RECORD — AVERAGES

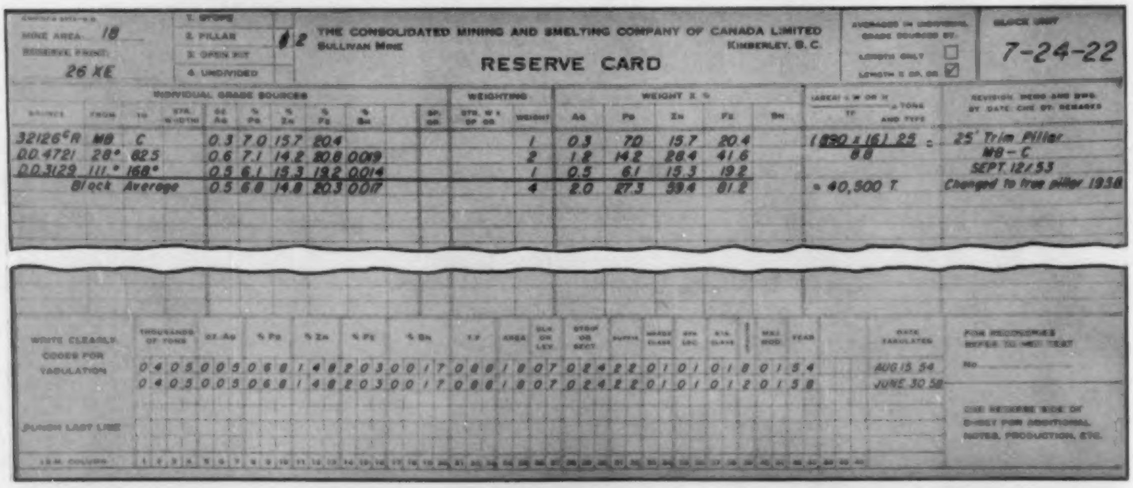
DISTRICT: KIMBERLEY, B.C.
OPERATION: SULLIVAN MINE

Plate	Geol. Sect.	Block	Place	Latitude	Departure	Elevation	Bearing	Dip	Length	H. Comp.	V. Comp.	Keep / Discard
29	15XE	X-22	2851 XCE	12701.63	6217.53	2861.46	S59°36'W	−70°	145.0	49.6	136.3	

Footage From	Footage To	SP GR	Description	Analysis Oz Ag	% Pb	% Zn	% Fe	% Sn	Cumul. Weight	Weight x Percent – Cumulative Ag	Pb	Zn	Fe	Sn	Composites Sn	Insol.
	38.2								102.0							
38.2	54.8		"C" to "I"	1	7	2.0	8.1	nil	47.7	4.8	32.6	94.0	388.1		0.01	78.0
54.8	145.0								240.8							

OBJECTIVE: Location of Sulphide Footwall CORE LOSS 6.4 CALC. BY JWC JW SECT. GN HOLE No. 5567
STRATION LOC. OF COLLAR: Hangingwall Siltstone INDEX CARD COMPLETED CHKD. BY HSA MINE SECT. WRS SHEET No. 2
DATE STARTED DATE COMPLETED CORE SIZE

Fig. 7



THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED
SULLIVAN MINE KIMBERLEY, B.C.
RESERVE CARD

MINE AREA: 18 RESERVE PRINT: 26 XE 1. STOPE 2. PILLAR 3. OPEN PIT 4. UNDIVIDED: 2
AVERAGED IN INDIVIDUAL GRADE SOURCES BY: LENGTH ONLY ☐ LENGTH X SP. GR. ☑
BLOCK UNIT: 7-24-22

Source	From	To	Oz Ag	% Pb	% Zn	% Fe	% Sn	Weight	Ag	Pb	Zn	Fe	Area / Tons	Remarks
32126^C R	MB	C	0.3	7.0	15.7	20.4		1	0.3	7.0	15.7	20.4	(890 x 16) 25 / 8.8 =	25' Trim Pillar
DD 4721	28°	62.5	0.6	7.1	14.2	20.8	0.019	2	1.2	14.2	28.4	41.6		MB – C
DD 3129	111.°	168°	0.5	6.1	15.3	19.2	0.014	1	0.5	6.1	15.3	19.2		SEPT. 12/53
Block Average			0.5	6.8	14.8	20.3	0.017	4	2.0	27.3	59.4	81.2	= 40,500 T	Changed to true pillar 1958

WRITE CLEARLY CODES FOR TABULATION

Codes	Date Tabulated
0 4 0 5 0 0 5 0 6 8 1 4 8 2 0 3 0 0 1 7 0 8 8 1 8 0 7 0 2 4 2 2 0 1 0 1 0 1 8 0 1 5 4	AUG 15 54
0 4 0 5 0 0 5 0 6 8 1 4 8 2 0 3 0 0 1 7 0 8 8 1 8 0 7 0 2 4 2 2 0 1 0 1 0 1 2 0 1 5 8	JUNE 30 58

PUNCH LAST LINE
USE REVERSE SIDE OF SHEET FOR ADDITIONAL NOTES, PRODUCTION, ETC.

Fig. 8

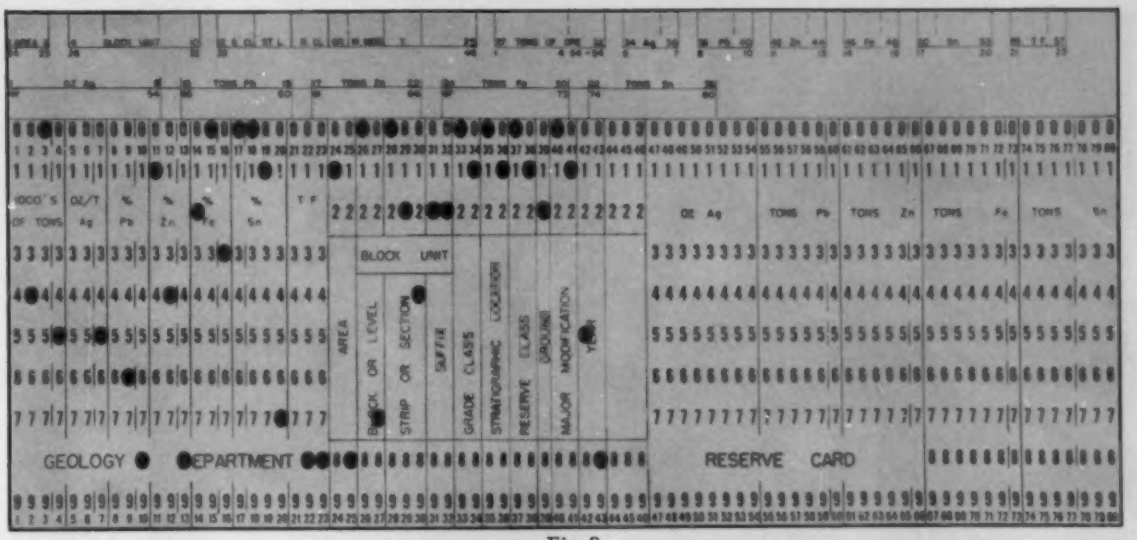


Fig. 9

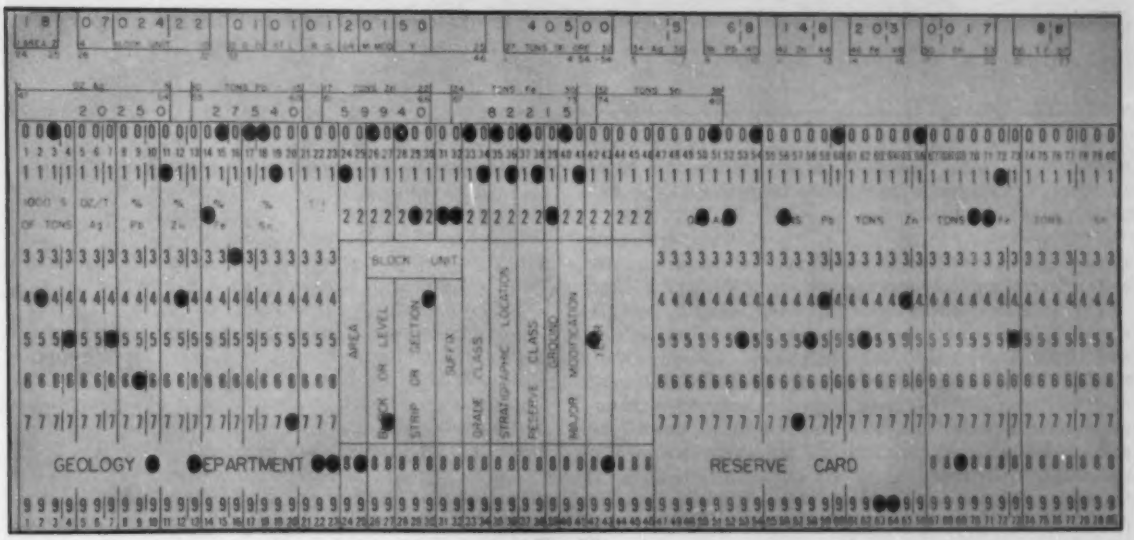


Fig. 10

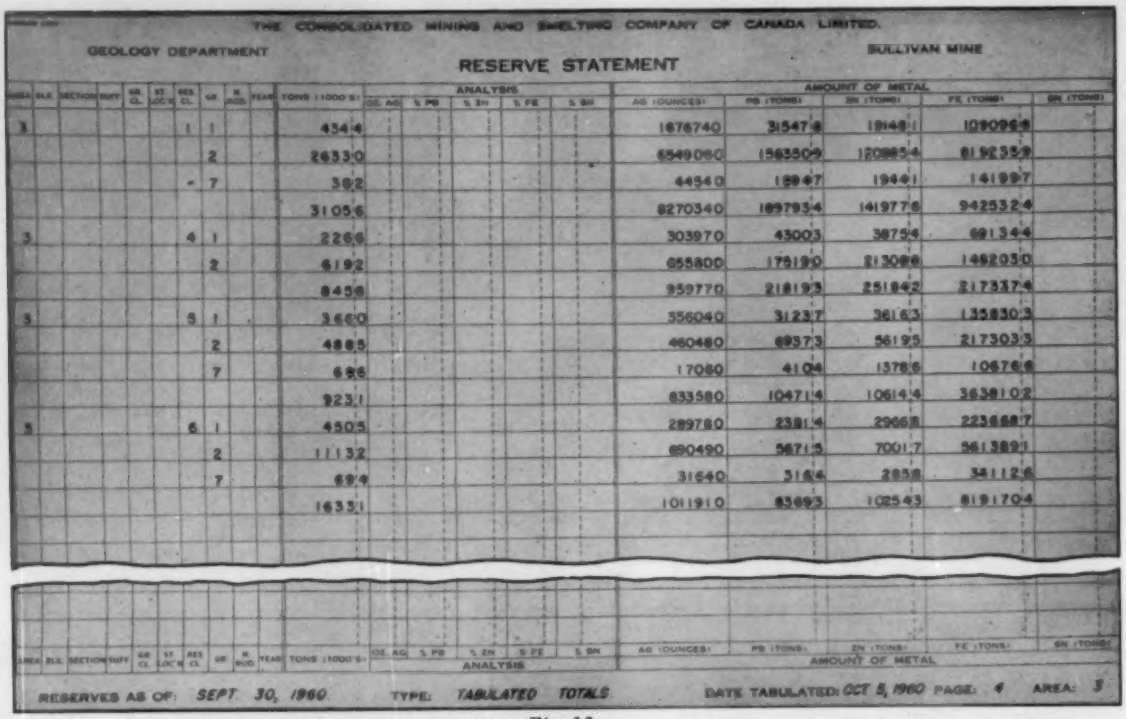
THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED

GEOLOGY DEPARTMENT — **RESERVE STATEMENT** — SULLIVAN MINE

AREA	BLK.	SECTION	SUFF.	GR. CL.	ST. LOC'N	RES. CL.	GR.	M. MOD.	YEAR	TONS (1000's)	ANALYSIS OZ. AG	% PB	% ZN	% FE	% SN	AMOUNT OF METAL AG (OUNCES)	PB (TONS)	ZN (TONS)	FE (TONS)	SN (TONS)
18	7	24	22	1	1	1	2	1	58	40.5	.5	6.9	14.9	20.3	.17	20250	2754.0	5994.0	8221.5	
	7	24	23	1	1	1	6	1	54	5.5	.4	6.9	15.1	20.2	.18	2200	374.0	830.5	1111.0	
	7	24	30	4	1	5	1	1	56	7.9	.1	.9	1.9	8.0		790	71.1	118.5	63.2.0	
	7	24	31	1	1	1	1	1	57	5.7	.2	.9	5.9	.9.9		1140	51.3	336.3	558.9	
	7	24	50	1	1	4	1	1	56	2.2	.4	4.5	7.7	13.2		880	101.2	169.4	290.4	
	7	28	20	1	1	1	2	1	53	118.9	.5	6.1	15.4	21.2	.17	59450	7252.9	18310.6	25206.8	

RESERVES AS OF: SEPT. 30, 1960 — TYPE: INDIVIDUAL LISTING — DATE TABULATED: OCT. 8/60 PAGE: 40 AREA: 18

Fig. 11



THE CONSOLIDATED MINING AND SMELTING COMPANY OF CANADA LIMITED.

GEOLOGY DEPARTMENT — RESERVE STATEMENT — SULLIVAN MINE

AREA	BLK	SECTION	SUFF	GR CL	ST LOC N	RES CL	GR	E MOD	YEAR	TONS (1000'S)	ANALYSIS OZ. AG	% PB	% ZN	% FE	% SN	AMOUNT OF METAL AG (OUNCES)	PB (TONS)	ZN (TONS)	FE (TONS)	SN (TONS)
3						1	1			4344						1676740	31547.8	19148.1	1090968	
							2			26330						6549090	1563509	1208854	8192352	
							7			302						44540	1894.7	1944.1	14199.7	
										31056						8270340	1897934	1419778	9425324	
3						4	1			2266						303970	43003	38754	691344	
							2			6192						855800	179190	213088	1482030	
										8458						959770	218193	251842	2173374	
3						5	1			3660						356040	31237	36163	1358303	
							2			4885						460480	69373	56195	2173033	
							7			696						17080	4104	13786	106766	
										9231						833580	104714	106144	3638102	
3						6	1			4505						289780	23814	29068	2236887	
							2			11132						690490	56715	70017	5413891	
							7			694						31640	3164	2858	341126	
										16331						1011910	83693	102543	8191704	

AREA	BLK	SECTION	SUFF	GR CL	ST LOC N	RES CL	GR	E MOD	YEAR	TONS (1000'S)	ANALYSIS OZ. AG	% PB	% ZN	% FE	% SN	AMOUNT OF METAL AG (OUNCES)	PB (TONS)	ZN (TONS)	FE (TONS)	SN (TONS)

RESERVES AS OF: SEPT. 30, 1960 TYPE: TABULATED TOTALS DATE TABULATED: OCT 5, 1960 PAGE: 4 AREA: 3

Fig. 12

and "shorts." The "spacer footage" column indicates how the various samples are to be grouped for determining average grades.

The sheets are now sent to the tabulating office where the following data are punched on core hole detail cards by the key punch operator. (Fig. 2): "hole number," "footage from—to," shorts, sample number, and analyses. If a spacer card (Fig. 3) should be required, it is punched as follows: "hole number," "footage from—to," "footage at—at" and "control X64." *A spacer card* is actually a summary card which contains a summation of the information on all the detail cards between it and the preceding summary card. It is locally called a "spacer card" because in one of the early stages its presence can be recognized on a listing by the fact that footage only is printed.

Next, a check run is made through the tabulator to prove the correct sequence of footage on the cards. The cards are now passed through the calculating punch to calculate the footage interval for each sample. The results are punched by the machine in the length feet column on each detail card (Fig. 4). At the same time the specific gravity of the material in each sample is calculated according to the following formula:*

$$\text{Sp. Gr.} = \frac{1120}{420 - (3 \times \%\text{Pb}\ 3 \times \%\text{Zn}\ 2 \times \%\text{Fe}}$$

* This formula relates change in specific gravity or tonnage factor as a function of %Pb, %Zn, %pyrrhotite, and %pyrite iron, assuming the specific gravity for Sullivan argillaceous sediment to be 2.70.

By changing the circuitry in the calculator through the use of another control board, feet × specific gravity, cumulative weight, and cumulative Ag are calculated and the machine summary punches cumulative weight and cumulative Ag from the last detail card to the summary card following. At the same time, the machine adds the footage for each detail card and punches the total in the "total length, ft" column of the same summary card (Fig. 5).

A third control board is introduced to complete the calculations on the detail cards, i.e., weight times pct—cumulative for lead, zinc, and iron. Then the information derived from the last detail card is punched onto the summary card following.

The information carried on the cards in the form of punches is now listed by the tabulator on pink 3-part continuous forms labelled: Development/ Diamond Drilling Sample Record—Assays (Fig. 6). The position of each summary card in the sequence can be readily found by the fact that footage is the only item of information printed.

The summary cards are now separated from the detail cards and they are passed through the calculator for division of cumulative weight for each metal by its own cumulative weight to arrive at the average grade for each sequence of samples. Average specific gravity is calculated at this point on the summary cards. This is done by applying the specific gravity formula to the average grade for each metal.

A check is now made of all the preceding calculations. The calculator divides cumulative weight on the spacer cards by core length (ft) and checks the result with the specific gravity already punched on the card. A tolerance of 0.02 is allowable and the machine will signify correct or incorrect by punching certain digits.

Data on the diamond drill summary cards (spacers) are worked through the tabulator and the information is listed on yellow continuous forms labelled, "Diamond Drill Sampling Record—Averages" (Fig. 7). These sheets are filed with the geologist's log of the core and the information is placed on 1 in.=40 ft scale geology sections where it is available for work on reserves.

CALCULATION OF RESERVES

Reserve statements at the Sullivan mine include not only an inventory of mineralized rock whose ton-

Main room of the Sullivan Mine's Tabulating Department where ore reserves are calculated from assay data.

nage and grade are known with sufficient assurance that they can be considered to be minable at a profit over the long term; they also include inventories of rock whose silver, lead, and zinc content are too low or whose extraction costs are too high to warrant classing them as ore. Blocks of these so-called doubtful reserves are listed in two groups based largely on grade. Experience has shown that under special circumstances, large tonnages of this material can be extracted profitably. So, well arranged and readily available information about these materials can be of excellent assistance in attaining maximum utilization of these lower grade reserves.

The procedure followed in calculating the reserves, in general, follows traditional practice. Ozalid prints of the geology sections that are oriented normal to the strike of the ore body constitute the work sheets for the calculations. They are spaced at 50-ft intervals. In addition to the wealth of geological information shown, they contain tables of assays and extensive groupings of assay averages for every core hole and development opening in mineralized rock. Boundaries for each reserve block are outlined by the geologists in the distinctive color assigned to each reserve class.

The volume of each block is determined by measuring its cross-sectional area with a planimeter and multiplying by the width. The grade of the block is estimated from the assay averages for the appropriate core holes and/or development openings. Inasmuch as some core holes may be better located within the block than others, the geologist usually has to apply some weighting factor to bring the degree of influence for each set of averages into reasonable balance. The average grade for the block is then calculated with a mechanical calculator. Once the average grade of the block has been calculated, the tonnage factor is determined by the aid of a nomograph based on the formula previously mentioned.

All these and other pertinent information about the ore block are assembled on an "Ore Reserve Card" (Fig. 8). There is one of these cards for each reserve block—4,000 in all. All revisions to the information on the cards are also shown for a reasonable period of years. All the data are then recorded by code in the columns at the bottom of the card to assist the key punch operators.

The reserve cards are sent to the tabulating office where the information is key punched onto a special reserve punch card (Fig. 9) and then passed through the verifier. The cards are fed to the calculating punch to determine the amounts of silver, lead, zinc, and iron, and sometimes tin, in each block. The machine punches these figures in the proper spaces on the card.

As soon as all the cards are processed in the calculator (Fig. 10), they are sorted according to reserve classes etc., and fed to the tabulator which prints the information desired on continuous forms (Fig. 11). From these listings, it is a simple matter to make up the final charts on a typewriter.

In addition to the above, other information on the cards can be picked out and punched into new decks in almost any combination desired through the proper use of the sorters, reproducing and summary punching machines, and then by feeding these new decks to the tabulator for printing (Fig. 12).

CONCLUSION

In concluding, it is perhaps desirable to point out that the objective in using these machines has been to do a job better and more efficiently than could be done otherwise—not to attain automation for its own sake. In presenting the results of our experiences with the use of electric punched card accounting machines, the author does not particularly wish to advocate the direct adoption of Cominco's methods to other operations but, rather, to stimulate interest in the use of the punched card method in this field.

DETERMINATION OF POWER CONSUMPTION

A study has been made of the crushing and grinding circuits by the Portland Cement Association in nine cement plants. Five of the plants used the wet process and four, the dry method. Both raw and clinker grinding were studied in the four dry processing plants. The raw materials used varied considerably from plant to plant.

Actual power consumption data were obtained for the majority of the grinding mills in these plants. Previously representative raw and clinker samples had been obtained from the nine plants, and Bond[1] and Hardgrove[2] grindability tests were run on these samples. All pertinent data concerning the grinding mills, such as mill size and speed, ball charge size and weight, size distribution of feed, and discharge materials were also obtained. Thus it became possible to calculate the actual horsepower used by the various mills, and to compare this figure to the theoretical horsepower as calculated by several different methods.

To calculate theoretical horsepower required by a grinding mill to reduce feed material to a certain size from Bond grindability test data, it is necessary to apply the "Bond Third Theory of Comminution."[1, 3] The first step in this procedure is to calculate from the following formula the *work index*, which is the kw-hr required to grind one short ton of material from a theoretically infinite size to 80 pct passing 100 microns:

$$Wi = \frac{16}{Gbp^{0.82}} \sqrt{\frac{Pi}{100}} \qquad [1]$$

where Wi = the *work index*
Gbp = Bond ball mill grindability
Pi = micron size of the mesh of grind.

For 200 mesh, $Pi = 74$; therefore

$$Wi = \frac{13.76}{Gbp^{0.82}} \qquad [2]$$

Using Hardgrove grindability test data, it has been reported by Bond that the "work index" can be obtained from the following equation:

$$Wi = \frac{435}{Hg^{0.91}} \qquad [3]$$

where Hg is Hardgrove grindability.

These three formulas are based on wet grinding. For dry grinding the work indices should be multiplied by 4/3.

Then, from the work indices the actual work required in kw-hr per ton to grind a material from a certain size F to a certain size P can be calculated using the following formula derived from the "third theory" of comminution:

$$W = 10Wi\left(\frac{1}{\sqrt{P}} - \frac{1}{\sqrt{F}}\right) \qquad [4]$$

where W = the work in kw-hr per ton
Wi = the work index
P = the 80 pct passing size in microns of the product material
F = the 80 pct passing size in microns of the feed materials.

As stated before, wherever possible the actual power consumption of grinding mills was obtained. By multiplying this mill power consumption figure by the output of the mill in tph of material and by 1.341, the actual horsepower consumed by a mill while grinding can be calculated. In a similar manner, horsepower figures can be obtained from theoretical power consumptions calculated from the Bond grindability test and from the Hardgrove grindability test. Also, a horsepower figure can be calculated from mill characteristics alone. This calculation can be made by use of a formula developed by Bond[4] and modified slightly by the author for the purpose of this article. The equation is:

$$hp = 1.341\ (W_b + 0.1\ W_b)$$

$$\left[D^{2.3}C_s(0.0616\text{-}0.000575\ V_p) - (0.1)2^{\left(\frac{C_s-80}{10}-1\right)}\right] \qquad [5]$$

where hp = horsepower
W_b = weight of ball charge in tons
C_s = pct of critical speed of mill
V_p = pct of total mill volume occupied by ball charge
D = mill diam (ft).

R. W. SMITH, Member of SME, is Assistant Professor at South Dakota School of Mines & Technology, Rapid City, S. D.

OF GRINDING MILLS IN CEMENT PLANTS

by ROSS W. SMITH

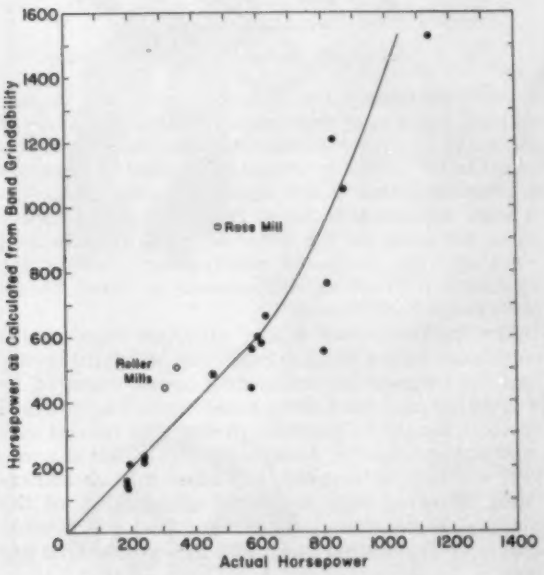


Fig. 1—Actual Hp vs Hp Calculated from the Bond Test.

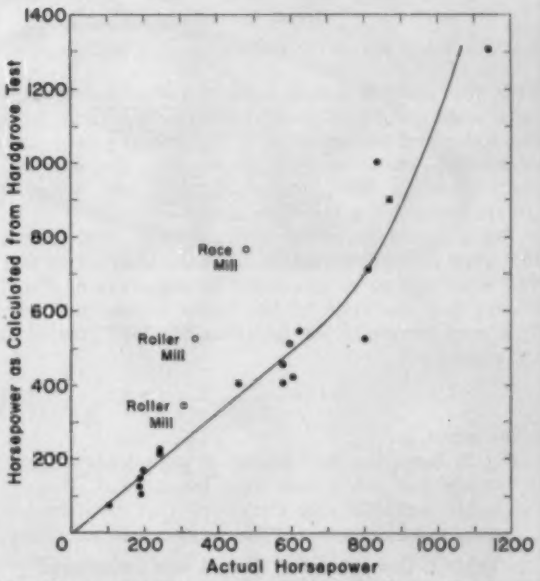


Fig. 2—Actual Hp vs Hp Calculated from Hardgrove Test.

The "0.1 W_s" term has been added to the equation to take into account the weight of raw material among the balls of the ball charge.

If the grinding mill being considered is a wet-diaphragm discharge mill larger than 8 ft in diam, the following term

$$\frac{(12D-60B)(D-8)}{240B}$$

where D = mill diameter (ft)
B = size of make up grinding media (in.)
must be calculated and subtracted from the term

$$D^{0.4}\,C_s\,(0.0616 - 0.000575\,V_p) - (0.1)\,2^{\left(\frac{C_s-60}{10}-1\right)}$$

in Equation 5. This is a *slump* correction. In addition, Bond has also calculated *friction corrections* for various types of grinding mills. However, as shown in Table I, the friction corrections apparently do not apply to limestone or clinker grinding mills used in the cement industry because the actual horsepower and theoretical horsepower agree without the use of the friction correction. Table I is a comparison of horsepower to individual grinding mills as calculated from the Bond grindability, the Hardgrove grindability, and Equation [5], with actual horsepower to the individual mills and rated horsepower of the mill drives also indicated. Immediately evident from Table I is the remarkably accurate agreement between the actual horsepower to a mill and the calculated horsepower figures.

The accompanying four graphs (Figs. 1 to 4) afford closer comparison of actual and theoretical horsepower. Fig. 1 shows the relationship of actual horsepower to horsepower as calculated from the Bond grindability. The relationship seems to be a straight line with a slope of *one* for smaller and medium-sized ball type mills. However, for the new large diameter mills (the three uppermost points are for mills of this type) the actual power required seems to be less than that calculated from the Bond grindability test.

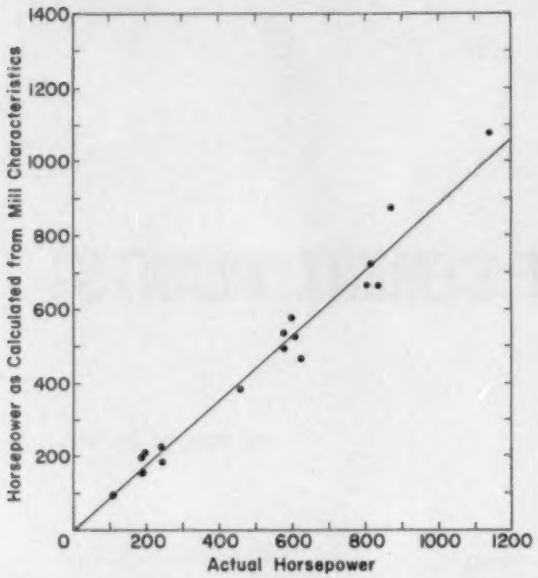


Fig. 3—Actual Hp vs Hp Calculated from Mill Features.

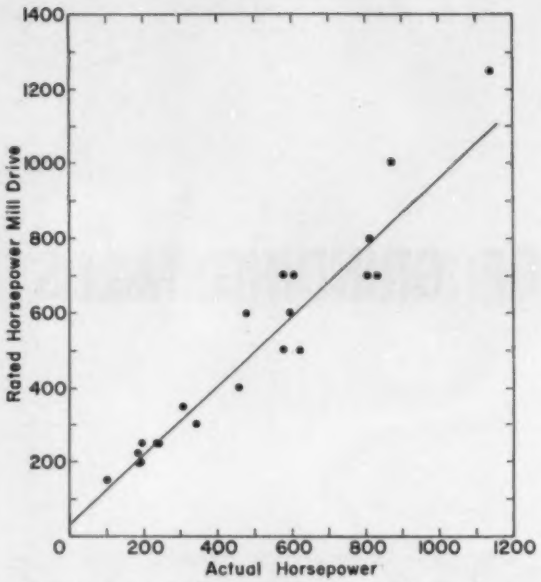


Fig. 4—Actual Hp vs Rated Hp of Mill Drive.

This phenomenon would seem to indicate that these mills are exceptionally efficient grinding units. Also, the roller and race mills tend to use less power than calculated—showing that these mills, too, are efficient grinding units. The roller and race mills, of course, require much maintenance.

Fig. 2 shows the relationship of actual horsepower to horsepower as calculated from the Hardgrove test. The resulting curve is similar to the curve of Fig. 1 except that the slope of the curve is less than *one*. This may be due to the fact that the "435" factor in the equation

$$Wi = \frac{435}{Hg^{0.91}} \qquad [3]$$

is too small.

Fig. 3 shows the relationship of actual horsepower to horsepower calculated from Equation 5. The remarkable straight line curve of this relationship shows how closely the required power can be calculated, using only mill characteristics. The slope of the curve is somewhat less than *one*, showing that a small factor probably should be applied to Equation 5. However, this factor appears smaller than the friction correction factor of Bond and would appear to be the same for the different types of mills used (wet and dry, long and short). Fig. 4 shows the relationship of actual horsepower to rated horsepower of the mill drives.

The curves shown should give one considerable confidence in the Bond grindability and third theory and the formula for calculating power required by a grinding mill from mill characteristics as practical tools. It should be possible, at least for cement raw material and clinker, to accurately calculate the correct size mill, mill speed, and other mill characteristics, knowing only the Bond grindability of the material to be ground, the desired feed and product size, and the desired output of the mill in tons per hour.

Table I. Comparison of Actual And Calculated Horsepower

Actual hp	Hp as calculated from bond grindability	Hp as calculated from Hardgrove Test	Hp as calculated from mill characteristics such as wt of ball charge, pct critical speed, etc.	Rated hp of mill drive	Remarks
199	212	170	208	250	
188	158	127	196	225	
102	91	75	95	150	
458	489	401	381	400	
623	663	544	462	500	
242	216	226	225	250	
508	600	512	574	600	
608	579	421	524	700	
578	563	409	533	700	
835	1213	1016	663	700	
870	1053	900	875	1000	
309	444	349	Not Applicable	350	Roller Mill
191	131	103	152	200	
478	940	765	Not Applicable	600	Race Mill
802	560	525	664	700	
243	232	218	185	250	
811	761	714	720	800	
1139	1525	1310	1076	1250	
343	510	528	Not Applicable	300	Roller Mill
577	443	458	492	500	
189	145	150	152	200	
—	927	938	635	700	
—	895	905	796	700	

REFERENCES

[1] F. C. Bond: Crushing and Grinding Calculations. *Pit and Quarry*, May 1952, pp. 118-119.

[2] R. M. Hardgrove: Grindability of Coal. ASME Trans., May 1932, vol. 54, no. 5, pp. 37-44.

[3] F. C. Bond: The Third Theory of Comminution. MINING ENGINEERING, May 1952, pp. 484-494.

[4] F. C. Bond: Crushing and Grinding Calculations. Allis-Chalmers Industrial Press Dept., 1956.

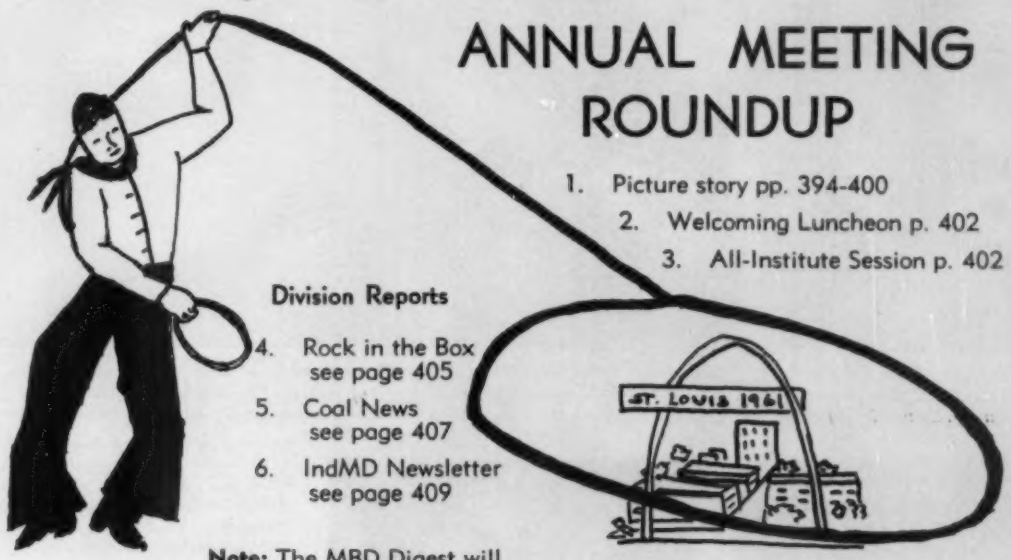
CORRECTION

Contrary to the statement made on page 154 of MINING ENGINEERING, February 1961, the San Carlos Exploration Co. is *not* a subsidiary of Hunting Geophysical Services, Inc. Hunting Geophysical Services, Inc. has been contracted by San Carlos Exploration Co. to provide exploration services.

It should also be noted that negotiations between the Papago Tribal Council and Hunting Geophysical Services, Inc., are still subject to final approval by the U.S. Department of the Interior.

SME BULLETIN BOARD

Reports of Your Technical Society



ANNUAL MEETING ROUNDUP

1. Picture story pp. 394-400
2. Welcoming Luncheon p. 402
3. All-Institute Session p. 402

Division Reports

4. Rock in the Box see page 405
5. Coal News see page 407
6. IndMD Newsletter see page 409

Note: The MBD Digest will appear in the May issue with its Annual Meeting report.

Utah Miners' Revue
see page 412

Forthcoming Meetings

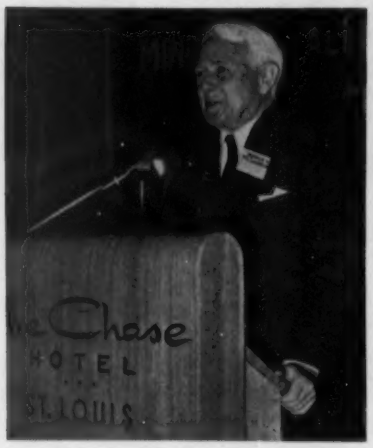
7. *Sixth Annual Uranium Symposium (p. 403)*
   May 12—14, Grants, N. M.
8. *Management of Materials Research (p. 402)*
   May 17—19, Harriman, N. Y.
9. *Froth Flotation Commemoration Meeting (p. 401)*
   Sept. 17—20, Denver

SME Preprint List
page 334

NOTE: Advertising in this issue has been added to the reader service card, p. 331. Circle, on the card, the "key" number given with the ad to obtain further information.

FOCUS ON ST. LOUIS

The first sight to capture the visitors' attention on entering the lobby of the Chase Hotel in St. Louis at the 90th Annual Meeting was an attractive display prepared by the St. Louis University Student Chapter of AIME. The Students responsible for designing it were John Tonnsen, display chairman; David Langan; and Thomas Linnevers. Fifteen companies were represented in the exhibit.



Donald H. McLaughlin presents his talk on the dollar-gold conflict at the All-Institute Session on Tuesday afternoon.

Highlighting the Welcoming Luncheon on Monday was the talk by the distinguished guest speaker Senator Thruston B. Morton.

There must be almost as many reasons for attending the Annual Meeting as there are people who attend. High on the list of reasons is the chance it provides for all of the members of the three Societies to get together at such all-Institute activities as the Welcoming Luncheon; Annual Banquet; the President's Reception; and, on the more serious side, the All-Institute Session—all of which are pictured on these pages. Shown below, a shot of the head table and part of the assemblage at the Welcoming Luncheon which featured, in addition to Senator Morton's speech, presentation of student awards in the Nineteenth National Student Prize Paper contest and the President's Award to the leading Local Sections in the membership application contest. A number of Student Chapters also received awards for the most new student applications.

The Annual Meeting means different things to different people. To the members of the Local Convention Committee it meant a job well done. To the AIME Board of Directors it meant a luncheon meeting and an executive session. To everyone—officers, members, and their ladies—it meant an opportunity to renew old acquaintances and to make new ones at the many social functions scheduled throughout the convention period. The gala event of this meeting, as always, was the Banquet and President's Reception held Wednesday night at the Chase Hotel. Following the Reception there was dancing in the Khorassan Room. A view of the head table and some of the diners in the picture at the top of the page catches some of the Banquet's festive spirit. To the right, the camera caught R. R. McNaughton, 1961 President of AIME, and his wife at a particularly animated moment during their stint on the receiving line in the Lindell Foyer. Their exuberant mood seemed to be contagious judging from all the smiles.

Secretary Ernest Kirkendall; Past-President J. L. Gillson; and R. R. McNaughton, this year's president, seated at center of table, pose with some of the AIME Directors in the Regency Room where the Board met for lunch in open session.

Some St. Louis Section members who contributed to the convention's success by committee service. Seated: Thomas Beveridge, Gordon Bell, Elmer A. Jones, R. H. Lowe. Standing: Roland Marquardt, V. W. Buys, Henry W. Heck, and Harold A. Krueger.

FOCUS ON ST. LOUIS

For SME members one of the most eagerly awaited events at the convention is the SME dinner. Above left at the cocktail hour preceding the dinner, J. C. Gray, SME's new president, receives congratulations from A. B. Cummins, Past-President. Above right A. B. Cummins, J. C. Gray, and W. B. Stephenson, engage in conversation with Curtis L. Wilson (second left) who was the dinner speaker.

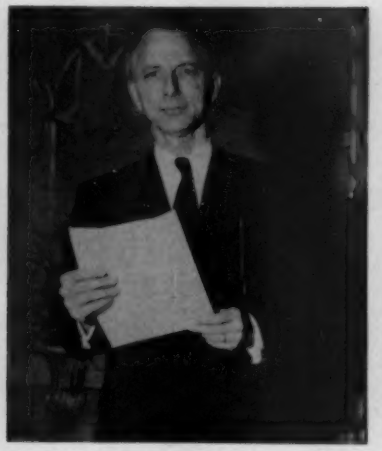
The SME Committee on Education met Sunday, February 26, at the Chase Hotel to take up where last year's session left off with a reappraisal of the needs of industry and the objectives of education as they apply to mining engineering. Featured on the program were Alvin W. Knoerr, Evan Just, and John J. Reed. In the picture at the left, from the left: George Clark, Evan Just, Don Forrester, Truman Kohn, John Reed, and Alvin Knoerr.

Division activities hold a special interest for SME members. Below, a picture of the M & E Luncheon. To the left John G. Hall, the new M & E Division Chairman, talks things over with Robert J. Lacy, Past-Chairman, before the Division luncheon. Above right C. F. Clausen, 1961 Chairman, Industrial Minerals Division, and R. H. Feierabend, Past-Chairman, enjoy a visit with J. L. Gillson before their luncheon. Directly to the right at the Coal Division luncheon, W. C. McCulloch, Division Chairman greets J. W. Woomer.

The most celebrated of all the Divisional events and the one most eagerly anticipated by the members is the traditional Scotch Breakfast staged by the MBDers. This year Division members and their guests gathered in the Chase Club on Tuesday morning to observe all of the familiar rituals from the piper escort to the mixing of the oatmeal with scotch. The picture to the right shows some of the jauntily hatted breakfasters enjoying their fare. Even the ladies made it—as the picture below right proves—although it meant getting up at the crack of dawn. The big event got off to a start at 7:30. On Thursday the MBDers returned to the Chase Club in a different mood for the Division luncheon to hear Nathaniel Arbiter address them. The picture at the bottom of the page focuses on the speaker's table during the height of the luncheon. In the picture directly below the cameraman caught W. B. Stephenson, SME President-Elect and Neil Plummer, the new chairman of the Minerals Beneficiation Division exchanging greetings before the luncheon.

FOCUS ON ST. LOUIS

Marcus D. Banghart receives the congratulations of J. L. Gillson at the Banquet.



G. E. Evans, Union Carbide Corp., speaks at the Industrial Minerals luncheon.

Donald H. McLaughlin, an award winner, accepts J. L. Gillson's felicitations.

The Annual Meeting is first and foremost people—members young and not so young, students, wives, children—converging for this event to exchange ideas, to learn, to be honored, to speak, and to meet colleagues amid the conviviality of the many social functions on the agenda. This year was no exception and neither the weather nor a crippling airlines strike kept people from turning out in force. On these two pages are a sampling of people who left their mark on the meeting—a distinguished company including speakers, officers past and present, honor members, and award recipients. To the left, two noted Canadian mining engineers, who are currently serving as presidents of their respective organizations, exchange greetings during the Annual Banquet. They are to the left, R. R. McNaughton, AIME President and to the right, W. H. Durrell, CIM President.

A distinguished group of men who have had a hand in guiding AIME affairs are shown at the Annual Banquet. Left to right some past-presidents of AIME: Andrew Fletcher (1953), John Suman (1941), Augustus B. Kinzel (1958), Michael L. Haider (1952), Donald H. McLaughlin (1950), Leo Reinartz (1954), Carl E. Reistle, Jr. (1956), Howard C. Pyle (1959), and Joseph L. Gillson (1960).

The highest honor that AIME can confer is election to Honorary Membership in the Institute. This year three more names were added to the distinguished list of members now holding that distinction. Above left René Victor Marie Perrin, president of Ugine, is congratulated by J. L. Gillson. Right, Carl E. Reistle, Executive Vice President of Humble Oil & Refining Co., receives his citation.

Pictured directly above, Thomas E. Millsop, this year's recipient of the Benjamin F. Fairless Award, accepts J. L. Gillson's congratulations at the Banquet.

The Annual Meeting provides many opportunities for people to get together who share common experiences. Pictured above right are the three men who, at the moment, have the most to do with guiding AIME affairs. They are from left to right: Lloyd E. Elkins, (Pan American Petroleum Corp.) President-Elect; Ronald R. McNaughton, (The Consolidated Mining & Smelting Co. of Canada Ltd.) President; and Joseph L. Gillson, (formerly of E. I. du Pont de Nemours & Co.) Past-President. This year's newly-elected Honorary Members took time at the Annual Banquet to pose together in the picture (right). From left to right they are: John Fairfield Thompson, René Victor Perrin, and Carl E. Reistle, Jr.

THE HONORS

Vincent D. Perry delivers the Jackling Lecture at the M & E session after lunch.

Hugo E. Johnson, left, and Rush Spedden, right, look on as R. R. McNaughton presents the Robert H. Richards Award to Nathaniel Arbiter at the MBD lunch.

One of the purposes of the Institute and its constituent Societies is to recognize the outstanding achievements made by members which are of lasting benefit to the professions they serve. It is for this reason that the highlight of the Annual Meeting is the presentation of Awards. Shown on this page are a few of the men so honored in the course of the Institute's 90th Annual Meeting. In the photo at the right Douglas W. Fuerstenau, Associate Professor of Metallurgy at the University of California, receives the Rossiter W. Raymond Award for his paper **Retention Time in Continuous Vibratory Ball Milling** *from his former teacher Antoine M. Gaudin. When Dr. Fuerstenau was a student at MIT he was one of Gaudin's A students, so it was most fitting that when it came time for Dr. Fuerstenau to be honored, his former teacher should be asked to make the presentation.*

This year's Extractive Metallurgy Division lecturer and former Richards Award recipient, A. M. Gaudin, talks to J. L. Gillson in the picture at the left. To the right, John F. Thompson, who was named Honorary Member of AIME receives J. L. Gillson's good wishes.

"On to Denver"

for the Froth Flotation Symposium

Embie, Jr. urges everybody interested in receiving more detailed information of the Commemoration of the 50th Anniversary of Froth Flotation in the USA to turn to page 331 and circle No. 100 on the business reply card found there, and get it in the mail today. If you miss this meeting, you won't have another chance for 50 years. Remember—"On to Denver in September"—as Embie, Jr. says.

This fall Denver will be host for a once-in-a-lifetime event in minerals beneficiation, when the 50th Anniversity of Froth Flotation in the USA will be commemorated on September 17, 18, 19, and 20. The meeting is sponsored by the Minerals Beneficiation Division of the Society of Mining Engineers of AIME, and all who are interested in minerals beneficiation are cordially invited to attended and take part in the technical meeting.

The technical program will feature 30 papers emphasizing the new, the novel, and the theoretical on six phases of froth flotation. These will be presented in six single, non-overlapping sessions by authorities for the U.S., Canada, Mexico, England, Italy, Chile, Peru, and India. General topics to be considered at the sessions are: New and Future Applications and Uses for Flotation; Kinetics of Flotation; Flotation Practice; Flotation Design; Flotation Mill Control; and Preparation of Ores and Minerals. All of the papers presented at the sessions will be available in the form of a bound volume to those attending. The cost of the volume is included in the registration fee.

Headquarters for the meeting are the Cosmopolitan Hotel and the Brown Palace. The morning sessions, from 9 am to noon, will meet at the former, and the afternoon ones, from 2 to 5, at the latter. A number of other hotels are within walking distance of these headquarters.

A full social program has been planned which at the same time allows some evening and noon hours open so that participants will have an opportunity to renew old acquaintances, make new ones, and enjoy Denver's many restaurants and after-dark activities. Social events scheduled include a registration cocktail party on Sunday, September 17; a welcoming lunch on Monday; a cocktail party-dinner dance on Tuesday; and on Wednesday, that traditional MBD specialty—the Scotch Breakfast. A special event for the ladies is also being planned.

Visitors to this Denver meeting will find that September is considered the peak season of the year by the residents. The weather is perfect, the Rockies are at their finest, and the summer tourist rush has abated so that trips from Denver to nearby attractions can be made in comfort; and accommodations are plentiful. Among the attractions are: the US Air Force Academy, Buffalo Bill's grave and museum, University of Colorado at Boulder, School of Mines at Golden, Central City (a restored Gold Rush town), Rocky Mountain National Park via Estes Park, Colorado Springs, and Pikes Peak.

It is still summer in Denver in mid-September. In the mountains the days are warm but the nights may be chilly enough to warrant a sweater or light topcoat. The weather will be ideal for golf on Denver's many private and public courses, and Colorado's favorite sport, trout fishing, will still be in season.

Here is a golden opportunity for an ideal vacation plus a not-to-be-repeated opportunity to take part in a meeting of great value to anyone interested in minerals beneficiation.

While plans are going forward for the Denver meeting, another committee under the chairmanship of D. W. Fuerstenau is hard at work on a commemorative volume to be published as part of the anniversary activities. The contents of the volume have been designed so that the entire book will be of general interest to all flotation engineers while certain chapters will be of specific interest to select groups, such as plant operators, design engineers, and educators. A sample of material covered in the 22 chapters follows: The Magnitude and Significance of Flotation in the Mineral Industry of the U.S.; Historical Outline of Major Developments in Flotation; Applied Flotation Research and Development; Flotation Machines; Mill Control; Flotation Economics; and Outlook for Flotation.

Among the contributors to the volume, all experts in their particular field of flotation, are: Charles W. Merrill, J. D. Vincent, F. F. Aplan, D. W. Fuerstenau, N. Arbiter, C. C. Harris, Clarence Thom, A. M. Gaudin, C. H. G. Bushell, S. D. Michaelson, and D. J. Brown.

The volume should be ready for distribution early in 1962. Because of the time lag in getting necessary information for 1960 statistics on the magnitude of the flotation industry, it has not been possible to arrange publication of the volume to coincide with the Symposium. The price of the book will be $12.00, less a 30 pct discount to AIME members. There will be an additional discount of 40¢ on prepaid orders, making the net cost to AIME members $8.00 for prepaid orders.

Members of the Editorial Committee serving under Mr. Fuerstenau are: F. E. Aplan, N. Arbiter, B. H. Clemmons, P. L. DeBruyn, E. W. Engelmann, W. L. Freyberger, F. C. Green, D. W. McGlashan, S. F. Ravitz, N. L. Weiss, and S. R. Zimmerley.

MBDers Contribute to Building Fund

The Minerals Beneficiation Division of AIME has contributed $2000 to the UET Engineering Societies Building Fund. The contribution was authorized by the Division's Executive Committee during its meeting Feb. 27, 1961.

Speech and Awards Featured at Luncheon

This year's Welcoming Luncheon was held Monday, February 27, at 12:15 pm in the Khorassan Room of the Chase Hotel. Joseph E. Gillson presided as one of his last functions as AIME President. Speaker for the occasion was Senator Thruston B. Morton, Chairman, National Republican Committee. His remarks ranged from government policy, to the electoral college, to how to get to Washington— go to Harvard and turn left.

The Welcoming Luncheon is traditionally the occasion for the presentation of the Student Prize Paper Awards, the President's Award, and the award to the winner of the AIME Student Chapter Contest. SME winners of the Student Prize Paper Awards were William G. Pariseau and Morris T. Worley. In the undergraduate division Pariseau received an award for his paper, *A Geologic Investigation of the Guye Iron Deposits*. He is a student at the University of Washington and his paper was entered by the North Pacific Section. Morris T. Worley won the graduate division award for his paper, *The Rare Earths—A Commodity Survey*. Worley is studying at the Missouri School of Mines, and his paper was entered by the St. Louis Section.

Local Sections who were winners of the President's Award this year were Utah Coal, Appalachian Petroleum, Mississippi, Denver Petroleum, and Pittsburgh for submitting the greatest number of membership applications in proportion to their membership in their respective groups; and Wyoming Mining and Metals, Hobbs, Mississippi, Cleveland, St. Louis, and Pittsburgh for submitting the largest number of applications.

The Colorado School of Mines Student Chapter won the $100 first prize for submitting the greatest number of Student Member applications. Pennants were awarded to five Student Chapters who were runners-up. They were: University of Texas, Missouri School of Mines, Louisiana State University, Montana School of Mines, and Brooklyn Polytechnic Institute.

Dollar-Gold Conflict Subject of Talk at All-Institute Meeting

One of the outstanding events of the Annual Meeting was the talk delivered by Donald H. McLaughlin, Chairman of the Board, Homestake Mining Co., at the All-Institute Session on Tuesday afternoon, February 28. The timeliness of his topic, *The Dollar-Gold Conflict* drew a large and very interested audience as evidenced by the numerous requests for copies of the talk. It was based on an article which he had prepared for publication in *The Commercial and Financial Chronical* of Jan. 12, 1961.

After considering, in passing, the complete repudiation of gold as an international monetary commodity and, more seriously, deflation as possible solutions to the present crisis brought on by the deficit in international payments against the U.S., Mr. McLaughlin suggested revaluation of the dollar as the only recourse.

The argument against deflation is that it is not likely to be the chosen course of a free society committed to the habits of an abundant economy since it entails reduced wages, lower costs, increased unemployment, and other conditions characteristic of a period of deflation.

The need for revaluation of the dollar, Mr. McLaughlin feels, is inevitable, and the sooner it is accomplished, the more beneficial its influence will be. In his own words:

"When this critical step is taken, it should be in accordance with a well prepared plan . . . It should not be forced abruptly—in response to panic pressures. . . .

"Particular emphasis must be placed on restoration of convertibility of the major currencies into gold without nullifying restrictions when the new gold content of the various monetary units becomes effective. . . .

"With such an honest and forthright move, the people of all participating countries would again enjoy the benefits of hard money and international exchange of currencies based on the stable value of gold . . ."

Metals Society to Sponsor May Meeting at Arden House

A conference designed to appeal to those who are concerned with the *management* of materials research and engineering, rather than such research and engineering itself, is being sponsored by the Metallurgical Society of AIME, May 17, 18, and 19, 1961 at Arden House, Harriman, N.Y. The program includes lectures, case history clinics, and workshops. Case studies and other necessary materials will be furnished to registrants in advance of the conference, and they will later receive a bound copy of the proceedings.

Among the topics to be covered during the meeting are: *Organization and Staffing of Industrial Research; Problems in the Management of Materials Research; Fundamental Values of the Scientist;* and *Fundamental Values of the Manager*. The workshops will consider the teachings of the conference; what can be learned about patents, publications, recruiting, financing, communications, etc.; and what topics should be covered at succeeding conferences.

Registration fees for the conference are $200 for members and $250 for nonmembers (these fees include room and board). Registration must be made on forms provided for that purpose. They may be obtained from: D. C. Johnston, The Metallurgical Society of AIME, 29 W. 39th Street, New York 18, N.Y.

Corrosion Short Course Offered for Sixth Year

The School of Mines of West Virginia University will again offer its Appalachian Corrosion Short Course on the college campus at Morgantown, W. Va., June 6, 7, and 8. This will be the sixth year that the course has been given. It will cover basic, intermediate, and advanced education of corrosion control practices as related to underground pipe, cable, and water systems. Approximately 70 papers are scheduled, plus field demonstrations. A copy of all the papers presented, in book form, will be sent to all persons attending the course.

For additional information write:
John H. Alm, Publicity Chairman
Dearborn Chemical Co.
2 Gateway Center
Pittsburgh 22, Pa.

Uranium Session Shifts to New Mexico for Sixth Annual Meeting May 12 to 14

Final plans have been made for the Sixth Annual Uranium Symposium which will be held in Grants, N. M. from May 12 to 14. The registration booth, located at the Grants Chamber of Commerce office, will open Thursday afternoon, May 11 with registration continuing all day Friday, and Saturday morning.

The program follows:

Friday May 12—Noon

Welcoming Luncheon

Speakers: *Edwin Meechem*, Governor of New Mexico
F. B. Howden, Mayor of Grants, N. M.
Salvador Milan, Mayor of Milan, N. M.

Friday May 12—2:00 to 5:00 pm

General Session

Project Plowshare—Promise and Problems by *Gerald W. Johnson*, Lawrence Radiation Laboratory, Livermore, Calif.

What the Uranium Industry Means to New Mexico by *Ward E. Ballmer*, Public Relations Associates, Grants.

Deep Well Construction for the Disposal of Uranium Mill Tailing Water by The Anaconda Co. by *Z. E. Arlin*, The Anaconda Co.

Friday May 12—7:00 pm

Cocktail Party and Banquet

Speakers: *Clinton B. Anderson*, U.S. Senator from New Mexico
R. R. McNaughton, President of AIME

Saturday May 13—9 am to 12 Noon

Milling Session

Moderator: *Jack Q. Jones*, Homestake-Sapin Partners, Grants, N. M.

Uses of Plastics in Uranium Milling by *Robert W. Burns*, The Galigher Co., Salt Lake City.

Maintenance Problems Peculiar to Mines Development Inc. Processing Plant at Edgemont, S. D., by *E. W. Davis*, Mines Development Inc.

Alkaline R.I.P. Plant at Moab, Utah by *Ted F. Izzo*, Uranium Reduction Co., Moab.

Handling of Total Ore in a CCD Thickener Circuit by *D. E. Millenbruch*, Union Carbide Nuclear Co., Uravan, Colo.

New Possibilities in Automation by *O. K. Neville*, Nuclear Chicago Corp., Des Plaines, Ill.

Mining and Geology Session

Moderator: *Richard Moe*, Phillips Petroleum Co., Gallup, N. M.

Open Pit Uranium Mining at Utah Construction and Mining Co.'s Lucky Mc Mine by *M. E. Pratt*, Lucky Mc Mine, Riverton, Wyo.

Radiation Control in Uranium Mines by *Robert G. Beverly*, Union Carbide Nuclear Co., Grand Junction, Colo.

Sand Filling at the Ann Lee Mine by *James Greenslade*, Phillips Petroleum Co., Grants.

Ground Support at the Pitch Mine by *James E. Dunn*, Pinnacle Exploration Inc., Gunnison, Colo.

Saturday May 13—12:30 to 2:00 pm

Milling Luncheon

2:00 to 4:30 pm

Milling Forum

Moderator: *H. J. Abbiss*, Homestake-Sapin Partners, Grants.

Radiological Control in Uranium Mills.

Panel Members: *Donald I. Walker*, AEC, Idaho Falls, Idaho; *Duncan A. Holaday*, U.S. Public Health Service; *Carl R. Jensen*, New Mexico Dept. of Health, Santa Fe, N. M.; *E. C. Hyatt*, Industrial Hygiene Group, Los Alamos, N. M.; and *Ralph M. Wilde*, The Anaconda Co., Grants.

Saturday May 13—12:30 to 2:00 pm

Mining and Geology Luncheon

2:00 to 4:30 pm

Mining and Geology Forum

Moderator: *John P. Herndon*, The Anaconda Co., Laguna, N. M.

Production Grade Control.

Panel Members: *Floyd J. Balentine*, The Anaconda Co., Laguna; *Tom Boyden*, Calumet & Hecla, Grants; *William Collins*, Hidden Splendor Mining Co., Grants; *Ted Rizzi*, Homestake - Sapin Partners, Grants; *Fred Hohne*, Kermac Nuclear Fuels Corp., Grants; and *J. T. Atkins*, Lucky Mc Mine, Riverton, Wyo.

Saturday May 13—7:00 pm

New Mexican Fiesta

Arrangements will be made for trips to the uranium mines and mills in the Grants area on Sunday, May 14 provided enough interest is shown. Registration for field trips should be made prior to 5:00 pm Friday, May 12 at the Chamber of Commerce Office.

In addition to the social events scheduled for the session to which the ladies are invited (i.e. Welcoming luncheon, Banquet, and New Mexican Fiesta), several special events have been planned for them. Friday afternoon there will be a tea at the home of Mr. and Mrs. Floyd Lee, Fernandez Ranch, San Mateo, N. M., and on Saturday, a luncheon and program at the Zuni Mountain Country Club.

The session promises to be an interesting one, so make plans now to attend and bring along your wife —she'll enjoy it too.

Short Course on Coal Preparation Offered

As a service to the coal industry, the School of Mines at West Virginia University, through its department of mining extension, will offer its eleventh annual short course in Coal Preparation, June 12 to July 21, 1961. The course is designed primarily for personnel actively associated with the industry to keep them abreast with rapidly changing coal preparation technology. In line with this objective, the course aims to provide an understanding of the basic techniques of coal preparation and their application to present day coal cleaning problems including: modification to existing plants, upgrading fine sizes, and the clarification of washery water and stream pollution.

The program includes both classroom and laboratory assignments, and represents a full-time schedule, with classes meeting from 8:00 am to 4:00 pm daily for the duration of the course. Reservations for the course may be made directly with the School of Mines. The fee for non-credit students is $16.00.

Additional information about the program may be obtained by writing the School of Mines.

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–57	601
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ROCK IN THE BOX

Mining & Exploration Division

Report from St. Louis: M & E Business Meeting

The annual business meeting of the M & E Division of SME was called to order in St. Louis on Wednesday afternoon, March 1. A turnout of 25 people attended to take part in the business conducted by the outgoing and incoming chairmen, R. J. Lacy and J. G. Hall, respectively. During the past year the Division accepted the invitation to represent AIME as a co-sponsor of a symposium on the Genesis of Certain Stratiform Ore Deposits. Other participants were to be Columbia University, New York Academy of Sciences, the Geological Society of America, and the Society of Economic Geologists. Unfortunately, disagreement among the societies on basic premises has caused indefinite postponement of this meeting. The Rock Mechanics Symposium, to be co-sponsored with Columbia University, was approved during the year. It will be held in 1964 in New York.

New Unit Committee Formed

Of interest to all members of the M & E Division was the invitation to the Geological Engineers to membership in AIME, through SME, as a unit committee in the M & E Division. On March 3rd, discussion of this proposal with the Geological Engineers resulted in their acceptance to be the sixth unit committee in our Division. Shirley A. Lynch of Texas A & M will be their first Unit Committee Chairman; William R. Higgs of Louisiana Tech, Membership Chairman; James N. Neilson of Michigan College of Mining and Technology, Program Chairman; and Parker D. Trask of University of California at Berkeley, Publication Chairman.

Division Objectives

Incoming Chairman, J. G. Hall, stated that the first objective of the new Executive Committee will be to solve the problem of committee continuity and organization in our Division. He appointed the Secretary to work with the various unit committee chairmen in order to produce manuals of procedures and to resolve a systematic progression for the continuity of committees. It was further stressed that all unit committeemen must keep headquarters informed of their progress. With the establishment of these working rules, the Vice Chairman of the Division will proceed to formalize a long-range plan for the future of the Division.

Second objective of the Division for the year will be the reactivation of the Peele Award. Jack Ehrhorn and Jack Fox were appointed to head up this committee. They will appreciate your ideas on financing of the Robert Peele Memorial Award. Other business stressed concerned a continuing of the effort to have fewer and higher grade papers presented for meetings, and the streamlining of the publication committee in order to expedite the acceptance of papers offered for publication. A vote of thanks was given J. W. Chandler for his excellent work as editor of *Rock in the Box* for the last two years.

The first annual SME meeting is to be held in Gatlinburg, Tenn., this fall. The East Tennessee Section offered to host this meeting and the SME Board accepted the invitation. By taking a first-class meeting to the members, the SME Annual Fall Meeting will generate greater interest in SME and AIME and will produce a more closely knit organization. This meeting will present opportunity that does not now exist for many of our younger members to take active roles in the Society's functions.

Of interest to all members is the effort being made at the Institute level to procure from the State Boards of Engineering Examiners a uniform program to ensure that professional men in the mineral industries are examined and licensed in the areas of their competence. Under present laws many states require examination in Civil, Electrical, Mechanical, or Chemical engineering to become registered. Every effort should be made to support AIME's program.

Building Fund

AIME's contribution to the United Engineering Center Building Fund has now passed the $480,000 mark—$500,000 was pledged. Although this is an excellent response, two-thirds of the members have not yet contributed. In order to go over the top, your help is still needed. If you have contributed, try to give a little bit more. If you are one of those who has not yet contributed, do not delay any longer. Please make your check out to United Engineering Trustees and mail it to Mr. E. H. Robie, c/o AIME 29 West 39 Street, New York 18, N.Y.

Council of Section Delegates

The Council of Section delegates is still doing business as usual. The committee selected last year to investigate this subject presented a majority report and a minority report. The former advocates drastic changes in the present set up. The latter favors maintaining the status quo with only relatively minor modifications. It was voted to study the problem further. Some members feel the division of delegates into representation by geographic areas would be beneficial. Others feel the *grass roots* flavor of the present set-up is meritorious. To facilitate a response truly representative of the memberships' needs, contact your section chairman and let him know how you feel on this matter. The biggest need appears to be for better organization and communication between the sections. Why not air your sentiments on this matter in *Rock in the Box*. Address correspondence to your news editor. — *B. Dellinger.*

The Jackling Award

The Jackling Award is an honor bestowed upon a person for "significant contributions to the technical progress in the fields of mining, geology, and geophysics."

The officers of the M&E Division certainly do not wish to be accused of running a closed shop, so Jack Hall, your Division Chairman, has specifically requested that we solicit your aid in choosing the next recipient.

The Jackling Award is one of the high honors that can be awarded by the Society and it certainly behooves

(Continued on page 406)

Rock in the Box

(Continued from page 405)

all of us to consider carefully whom we nominate to receive it.

Would you please send your comments and suggestions before May 1 to:

Jackling Committee
c/o John G. Hall
National Lead Co.
Tahawus, New York

About the D. C. Jackling Award and Lecture

The Daniel C. Jackling Award and Lecture was instituted by the Mining, Geology and Geophysics Division (now the Mining and Exploration Division of SME) of the Institute in 1953. Daniel C. Jackling, for whom the Award is named, was an Honorary Member of AIME and was President in 1938. The Award consists of a bronze plaque and is presented for "significant contributions to technical progress in the fields of mining, geology, and geophysics." (With the change in the structure of the Division these three are considered in their broader sense and cover any Unit set up by the Mining and Exploration Division.)

The Committee under MGG sponsorship was set up as follows:

Chairman of the MGG Division (Chairman)
Past Chairman of MGG Division
3 Past Vice Chairmen of MGG
3 Additional Members appointed by the Chairman
(Total 8 Members)

This procedure was satisfactory under MGG Bylaws but did not fit M&E Division set-up. Accordingly, the rules were revised to fit the new organization. The Committee now consists of:

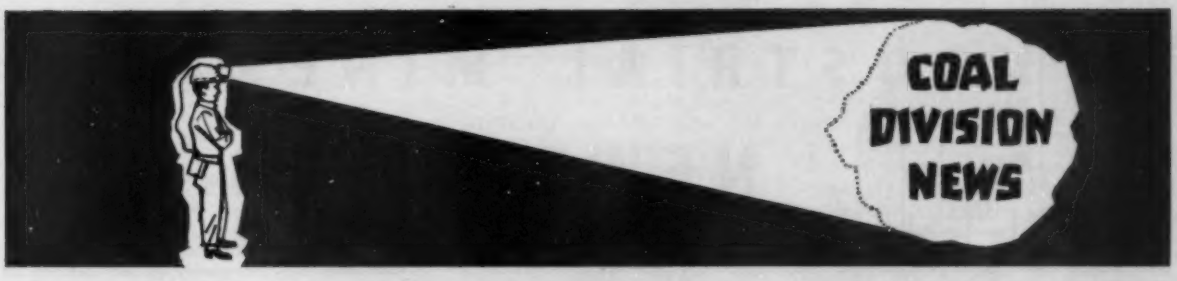
Chairman of the M&E Division (Chairman)
Past Chairman of the M&E Division
5 Past Unit Committee Chairmen
1 Additional Member appointed by the Chairman
(Total 8 Members)

The Award winner is chosen by the Board of Directors of SME upon recommendation of the Award Committee.

The Award is a bronze plaque with an engraved citation and the title of the lecture; a page in the Honor's booklet; and MINING ENGINEERING generally publishes the lecture.

Cost of the award is covered by a fund set up for this purpose under D. C. Jackling's will. The Plaque is presented each year at the Annual Meeting during the M&E luncheon. It is generally presented by a distinguished friend of the recipient invited by the Chairman at the suggestion of the recipient.

The lecture is usually given at a special afternoon session following the M&E luncheon.



Notes Off the Cuff- St. Louis 1961

Perez Featured at Division Luncheon

If attendance indicates a successful meeting, then the 90th Annual Meeting at St. Louis can be considered tops for the Coal Division. Attendance at the sessions was probably the largest the Division has had to date. The luncheon, Tuesday, February 28th, in the Zodiac Room of the Chase Hotel, drew a crowd of 159. Jose Perez, Department of Natural Resources, Mexico City, was guest speaker. His talk on the coal situation in Mexico proved to be excellent. Most of their coal is used for metallurgical purposes. He mentioned that at present there are more than 100 localities where coal is known to be found. Of this number, five or ten are important for coal production. The northeast section of the country accounts for all of the coal now being produced. Mr. Perez went on to discuss each of the zones in terms of its geology.

Business Meeting

The Coal Division held its business meeting Tuesday afternoon in the Georgian Room of the Park Plaza Hotel. At that time officers for the year were elected as follows:

William C. McCulloch—*Chairman*
D. R. Mitchell—*Chairman-Elect*
George E. Keller—*Secretary-Treasurer*

Elected Members of Executive Committee:
Henry J. Hager
W. A. Weimer
James D. Reilly

See MINING ENGINEERING, July 1960, page 849 for biographies and photographs of your new officers.

Another important item on the agenda was amendments to the Division By-laws. See MINING ENGINEERING, December 1960, page 1279 for text of the proposed amendments. It was voted to adopt these amendments.

The following resolution was also put forward at the meeting:

WHEREAS, G. R. Spindler was for many years active in the coal industry of this country and abroad in various capacities, namely,

Dean of The School of Mines of West Virginia University

Chief of West Virginia Department of Mines

Secretary of the West Virginia Coal Mining Institute

Member of Advisory Committee, Office of Coal Research, Department of the Interior

WHEREAS, He was a notable mining educator, devoted to his profession, as professor of mining engineering at West Virginia University, and,

WHEREAS, During the war he also conducted mining courses for the British Government for the purpose of increasing their coal production, and,

WHEREAS, His sudden passing at the height of his career has been a great loss to the coal industry and the mining and educational professions,

THEREFORE, BE IT RESOLVED:

That the Coal Division of the Society of Mining Engineers of AIME extend their condolences to his family and make this resolution a part of the minutes of its annual meeting held in St. Louis, Feb. 28, 1961.

From notes by *George E. Keller.*

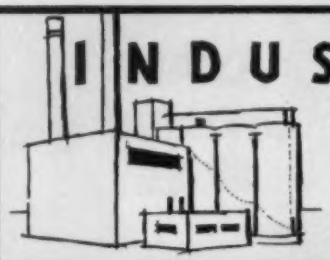
Seated at the speaker's table at the Division luncheon Tuesday are from left: Edward G. Fox; William C. McCulloch; James D. Reilly, who introduced the speaker; Jose Perez, speaker; H. O. Zimmerman; and Ronald R. McNaughton, AIME President.

Coal Preparation Plant Design Session

The session on Coal Preparation Plant Design held Monday morning, February 27 was an especially good one. About 85 people attended and only one or two left during the meeting. The close attention paid by the audience to all of the papers indicated both their value and interest. The session was made up of three related papers dealing with plant design, and presented, in addition to regular descriptive data, design features permitting operating and maintenance economics.

Of the three plants covered, the presentation of the Loveridge plant by H. L. Washburn and W. A. McConnell (Mr. Washburn delivered the paper) caused the most comment. The other plants discussed were Thunderbird Collieries and the coal preparation plant facilities of Old Ben Mine No. 21.—From report by *F. R. Zachar.*

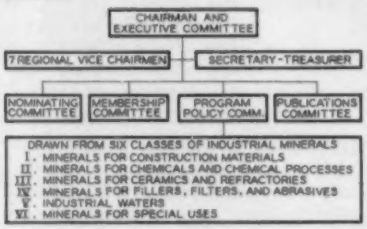
COAL DIVISION
NEWS EDITOR
RAYMOND E. DAWSON
Roberts & Schaefer Co.
201 North Wells Street
Chicago 6, Ill.



INDUSTRIAL MINERALS NEWSLETTER

Reorganized Industrial Minerals Division, 1961

In accordance with the changes in the Bylaws of the Industrial Minerals Division, the organization chart shown on page 236 of the March 1960 issue of MINING ENGINEERING is now obsolete. A new chart is presented:



The officers, elected and appointed, who will serve during the year are as follows:

OFFICERS

Carl F. Clausen, Chairman
Portland Cement Assn.
5420 Old Orchard Road
Skokie, Ill.

Leon W. Dupuy, Secretary Treasurer
U.S. Bureau of Mines
[Address Division mail to home:
2475 Virginia Avenue, N. W.
Washington 7, D. C.]

G. F. Pettinos, Jr., Northeast Vice Chairman
George F. Pettinos Inc.
1206 Locust Street
Philadelphia 7, Pa.

F. R. Hunter, Mid-Continent Vice Chairman
International Minerals & Chemicals Corp.
5401 Old Orchard Road
Skokie, Ill.

Fred Lohse, Pacific Southwest Vice Chairman
Consulting Process Engineer
295 Crummer Lane
Reno, Nev.

H. E. Uhland, Southeast Vice Chairman
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Lakeland, Fla.

R. H. Wilpolt, Rocky Mountain Vice Chairman
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Spokane 41, Wash.

W. T. Bray, Canadian Vice Chairman
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Portland Cement Assn.
5420 Old Orchard Road
Skokie, Ill.

R. H. Feierabend, Past Chairman
Freeport Sulphur Co.
P. O. Box 1520
New Orleans 5, La.

Leon W. Dupuy, Secretary Treasurer
Apartment 817
2475 Virginia Avenue, N. W.
Washington 7, D. C.

Plus seven Vice Chairmen listed above, and:

Until February 1962

T. E. Gillingham, Jr.
615 Market Street
Oxford, Pa.

Lauren A. Wright
California Div. of Mines
Room 402B, State Bldg.
217 W. 1st Street
Los Angeles 12, Calif.

John B. Patton
Indiana Geological Survey
Bloomington, Ind.

Until February 1963

Leon W. Dupuy
U.S. Bureau of Mines
Washington 25, D. C.

R. F. Brooks
Gladding, McBean & Co.
2901 Los Feliz Blvd.
Los Angeles 39, Calif.

Pauline Moyd (Mrs. L.)
136 Park Avenue
Yonkers, N. Y.

Until February 1964

J. S. Holland
National Lead Co.
111 Broadway
New York 6, N. Y.

R. H. Johns
Professor of Geology
Chairman, Div. Earth Sciences
The Pennsylvania State University
University Park, Pa.

R. S. McClellan
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Raphael G. Kazmann, Chairman
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(Representing Classification V)

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(Three-year term, expiring Feb. 1964)
(Representing Classification III)

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Box 1520
New Orleans, La.

John G. Broughton ('59)
N. Y. State Museum & Science Service
State Education Building, Room 448
Albany 1, N. Y.

R. M. Grogan ('58)
Development Department
E. I. du Pont de Nemours & Co.
6015 du Pont Building
Wilmington 98, Del.

Thomas L. Kesler ('57)
Foote Mineral Company
P. O. Box 792
Kings Mountain, N. C.

R. B. Ladoo ('56)
42 Huntington Road
Newton 58, Mass.

(Number in parenthesis indicates year of chairmanship of Division.)

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Hubert D. Keiser
7005 Maple Avenue
Chevy Chase, Md.

H. I. Smith
3700 Massachusetts Ave., N. W.
Washington 16, D. C.

Richard W. Smith
Natural Resources Department
Chamber of Commerce of the U.S.
1615 H Street, N. W.
Washington 6, D. C.

Paul M. Tyler
5005 Edgemoor Lane
Bethesda, Md.

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Consulting Geologist
6526 Holiday Drive
Boise, Idaho

Philip S. Hoyt
Philip S. Hoyt & Son
6918 Earll Drive
Scottsdale, Arizona

Robert Ingalls
Ingalls Stone Co.
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Yonkers 3, N. Y.

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Mackay School of Mines
University of Nevada
Reno, Nev.

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Geology Division
Development Department
E. I. du Pont de Nemours & Co.
Wilmington 98, Del.

Franklin J. Weishaupl
American Potash & Chemicals Corp.
3600 West Sixth Street
Los Angeles, Calif.

1961 REPRESENTATIVES ON SME COMMITTEES

SME Admission Committee

R. T. Lassiter
Western Knapp Engineering Co.
50 Church Street
New York 7, N. Y.

L. P. Warriner
452 Fifth Avenue
New York, N. Y.

SME Mineral Economics Committee

R. J. Lund
Battelle Memorial Institute
505 King Avenue
Columbus, Ohio

SME Education Committee

Professor J. J. Schanz, Jr.
The Pennsylvania State University
University Park, Pa.

SME Nominating Committee

Members: T. L. Kesler
Foote Minerals Co.
P. O. Box 792
Kings Mountain, N. C.

Gill Montgomery
Mining Division
Minerva Oil Co.
Box 531
Eldorado, Ill.

Alternate: F. C. Kruger
Mining and Exploration Dept.
International Minerals & Chemicals Corp.
5401 Old Orchard Road
Skokie, Ill.

SME Annual Meetings Committee

Henry J. Schwellenbach
Vice President, Production
New York Trap Rock Corp.
Old Mill Road
West Nyack, N. Y.

HARDINGE AWARD COMMITTEE

R. H. Jahns, Chairman, 1960-61
(Term expires in 1962)
Division of Earth Sciences
The Pennsylvania State University
University Park, Pa.

A. B. Cummins (1962)
Research Center
Johns-Manville Co.
Manville, N. J.

T. L. Kesler (1963)
Foote Mineral Co.
P. O. Box 792
Kings Mountain, N. C.

R. M. Foose (1964)
Stanford Research Institute
Menlo Park, Calif.

R. M. Grogan (1965)
Development Department
E. I. du Pont de Nemours & Co.
6015 du Pont Bldg.
Wilmington 98, Del.

J. B. Patton (1963)
Department of Geology
Indiana University
Bloomington, Ind.

R. J. Lund (1964)
Battelle Memorial Institute
505 King Avenue
Columbus 1, Ohio

W. T. Bray
Canadian Refractories Ltd.
Kilmar, Inc., Canada

C. F. Clausen, Ex Officio
Portland Cement Assn.
5420 Old Orchard Road
Skokie, Ill.

Minerals Vs. Other Resources
An Annual Meeting Report

A symposium on Conflicting Interests in the Exploitation of Industrial Minerals demonstrated that keen interest and early negotiation on the part of mineral industrialists are vital to obtaining optimum multiple use of all resources. The papers presented described several phases of competition for land use. Included were urbanization, highways, water reservoirs, and withdrawals of lands for single-purpose use (rather than multiple use to which this country has so long been dedicated).

Orris Herfindahl, of Resources for the Future, discussed the economic problems related to competitive land uses and painted a broad future of such problems facing the industry.

The encroachment of urbanization on the mineral industry was discussed by Harold B. Goldman of the California Division of Mines. He told of some successful zoning procedures followed in Los Angeles where farsighted county supervisors have assured continued sand, gravel, and rock production.

Water reservoir problems of the mineral industry were described by Thomas Maddock of USGS. The session was aptly highlighted when he commented, "Our symposium is an expression of a concern of how our resources can be developed."

The land withdrawal vs. mining situation was described in a paper by H. M. Dole of the Oregon Department of Geology and Mineral Industries. Mr. Dole's paper was read by Francis X. Cappa of the Aluminum Corp. of America. The audience was especially startled to learn that 51 million acres of the public domain in the State of Alaska are undergoing withdrawal procedures at the present time. Wilderness areas, bird sanctuaries, wildlife refuges, and military are involved. Mining and prospecting, it is reported, would be prohibited on the withdrawn lands.

Attendance at the session ranged from 34 at the beginning to 47 just before the coffee break. The interest of the audience was demonstrated by active discussion and the receipt of many inquiries as to when the papers would be published. Also, future papers and studies were requested that would discuss zoning problems of the mineral industry. This would include urban zoning, farm zoning, flood plain zoning, use zoning (as in New Jersey, where sometimes you can mine all you want but cannot remove soil from the premises), and separable industry zoning.—*Leon W. Dupuy.*

Education News

Lima, Peru Section Scholarship Program

The Education Committee of the WAAIME reported on its activities at the Lima, Peru Section annual dinner, and asked for assistance in sending two 1960 graduates of the National Engineering University of Lima to the U.S. for further study. The response was generous.

One of the young men, Felipe de Lucia, who had been given a scholarship for three years by the committee, received a grant to cover a year's post-graduate work at the University of Arizona from Impact Inc. which is owned and controlled by the employes of C. Tennant Sons Co. He left for the U.S. early in January on a Fulbright travel grant.

ECPD

The first step toward increasing the engineering population to meet future needs is to attract additional qualified high school students to the study of engineering. This objective is being carried out by the guidance committee of the Engineers Council for Professional Development through a network of state committees which works directly with the schools. (For a list of the committees, and detailed information on the program see pp. 594-596 of the June issue of MINING ENGINEERING.) The ECPD state committees were organized during the Korean War when the shortage of engineers was reaching critical proportions. There are now committees in all 50 states, the District of Columbia, and Canada. The work is coordinated by the ECPD National Guidance Committee through eight region chairmen.

The ECPD National Guidance Committee supports the work of the state committees through two annual mailings to the nation's 30,000 high schools. Information on engineering is also sent to the directors of summer institutes sponsored by the National Science Foundation for mathematics and science teachers, and by the U.S. Office of Education for counselors. Last summer, 485 institutes having an estimated enrollment of 16,000 teachers and 3,800 counselors were reached in this manner.

Scholarship Set Up by Society of Exploration Geophysicists

An outstanding foreign student will receive a $750 scholarship to study geophysics in the U.S. this year as a part of the Society of Exploration Geophysicists' people-to-people program of aid to geophysical education and research throughout the free world. The scholarship committee of the SEG Foundation will select the student from nominations made by affiliated societies in Europe, South America, and Africa, and by SEG members working in other countries.

From left: Felipe de Lucia, recipient of grant, Mrs. John Burgess, chairman WAAIME educational committee, Lima, Peru; and Wilber Deming, manager C. Tennant Sons.

High School Students Visit Battelle Memorial Institute

At the invitation of the Women's Auxiliary of the AIME Ohio Valley Section, students of local high schools paid a visit to Battelle Memorial Institute on December 7. J. Harry Jackson, manager of the metallurgy department addressed the students, and after a tour of more than 12 of the Institute's facilities, C. H. Lorig and H. O. McIntire answered questions. The students had lunch at the Institute and were also addressed by officers and members of AIME. The WAAIME hostesses for the occasion were Mrs. J. H. Jackson, Mrs. A. R. Elsea, Mrs. Mars Fontana, Mrs. E. E. Underwood, and Mrs. H. B. Goodwin.

Southern Methodist University Receives NSF Grant

The National Science Foundation has awarded Southern Methodist University a grant of $26,400 to conduct a basic study of the feasibility of making the new Science Information Center on campus a regional scientific and technical information center serving the needs of Southwestern industry and higher education. The study sponsored by the National Science Foundation is scheduled for completion in May. It will be based to a large extent on personal interviews and questionnaires aimed at the scientists and technicians who are engaged in research in the Southwest. Also involved in the study are visits to, and detailed studies of existing scientific information centers and an economic study of the area done by business economists.

The Anaconda Co.

Two scholarships for undergraduate students in mining, metallurgical, or geological engineering have been established at Montana School of Mines by The Anaconda Co. for the benefit of deserving students who are sons or daughters of employes of Anaconda or its subsidiary companies at any of the organization's Montana operations.

Anaconda will provide $3000 annually to maintain these scholarships. If they maintain their scholastic standards, recipients can renew the scholarships each year until graduation. The students will be chosen annually by the School of Mines Scholarship Committee.

Louis Ware Scholarships

Twelve students at leading mining and agricultural colleges have been named winners of the first Louis Ware senior-year scholarships. The $1000 awards are sponsored by International Minerals & Chemical Corp., Skokie, Ill. In addition, the six winners in each category become eligible to compete for $3000-a-year, three-year fellowships, one in mining and one in agriculture. Winners of the 12 awards are chosen annually by special faculty committees at each school, and compete in their senior year for the fellowships. The awards are named in honor of Louis Ware, who was for 20 years the president of the sponsoring corporation.

Society of Sigma Xi Research Grants

The Society of the Sigma Xi, an organization founded for the encouragement of scientific research, awards annual grants-in-aid to recommended research projects in amounts from $50 to $500. A recent recipient of such a grant is D. B. Slemmons, professor of geology at the Mackay School of Mines, University of Mines. He has been awarded $450 to further his investigation of the optical properties of feldspars.

Around the Sections

• **The Eastern North Carolina Subsection** (Carolinas Section) has announced the following officers for 1961: Phil M. Brown, chairman; Virgil Mann, vice chairman; E. L. Miller, Jr., secretary-treasurer; John M. Parker, III, and S. Duncan Heron, Jr., members of the executive committee.

On Saturday night, February 18, members, wives, and guests met at Harvey's Cafeteria in Durham, N.C., for a social hour and dinner. John E. Johnston, assistant chief of the fuels branch, USGS, was speaker of the evening. The subject of his talk was *Petroleum Potential of the Atlantic Coastal Plain*, with particular reference to North Carolina.

• **The Burkhart Mining Society** (Student Chapter of Virginia Polytechnic Institute) held its first meeting of the year on January 17. John Noble, a graduate of Sheffield University and presently a graduate student in mining engineering at VPI, gave a talk on longwall mining of coal. Another order of business was the appointment of a committee to plan the exhibit for the annual engineering conference to be held on campus this spring.

• Members of the **El Paso Section** saw a film presentation entitled *Operation Abolition* at the February 8 meeting held at the Hotel Cortez. The motion picture, sponsored by the El Paso Police Department and the 133rd Artillery of the Texas National Guard, was shown by D. B. Murray, a police sergeant.

• The **Student Chapter of the Colorado School of Mines** heard DeWitt C. Derringer, one of the school's most distinguished graduates and recipient of its Merit Award, at its January meeting. *Job Opportunities in Latin America* was the subject of the program, during which a short movie on living and job conditions was shown, and a brief talk was given, followed by an informal question-and-answer period. Mr. Derringer has spent over 20 years in Latin America as manager of several mining enterprises.

• Members of the **St. Louis Section** heard an illustrated talk covering the conception, design, and construction progress of the first purely pumped storage hydroelectric project in this country at their meeting February 10 held in the Hotel York. E. A. Rudolph, manager of the Taum Sauk Project, Union Electric Co., gave the presentation.

• The annual meeting of the **Cleveland Section** with the Women's Auxiliary was held January 19 at the Cleveland Engineering and Scientific Center. Following cocktails and dinner the assemblage heard Robert C. Clark, public activities supervisor of Ohio Bell Telephone Co., give a lecture-demonstration on television and television-transmission. The talk was nontechnical and was of interest to the ladies as well as the men.

• 1961 officers were installed at the January 5 meeting of the **Maricopa Subsection** (Arizona Section) as follows: A. W. Miller, chairman; Albert Mendelsohn, vice chairman and program chairman; and Luther S. Helms, secretary-treasurer. Members met at the Arizona Ranch House Inn, Phoenix, where they heard Charles R. Kuzell present a talk, *Development of Copper Smelting from B.C. to P.D.* Mr. Kuzell is president of Apache Power Co. and retired vice president of Phelps-Dodge Corp.

At the February 2 meeting also held at the Arizona Ranch Inn, Denison Kitchell gave a talk entitled, *Need of and Prospects for Additional Federal Labor Legislation*. He is a recognized authority on labor relations and served as one of the U.S. representatives at the International Labor Group at Geneva, Switzerland.

• **Tucson Subsection** (Arizona Section) met February 8 at the Holiday Inn. to hear Thorp Sawyer, consulting engineer, discuss gold dredging in Columbia, South America. He also showed a film which pictured the operation of dredges, and read a portion of a technical paper he has prepared entitled, *Early History of a Famous Placer*. Among the 83 people attending the meeting were 14 students from the University of Arizona and a number of members of the mining profession visiting Tucson.

The New York Section Held a Dinner Dance January 27

Everybody who's anybody was there and they all had a good time at the Waldorf.

The chairman of it all, George P. Lutjen, seems to be pleased by the festivities.

Everyone got out there and danced at the Waldorf Astoria as the evening wore on.

Rex's Court: Mrs. E. V. Hanna, Mrs. Phil Mudgett, Milton Williams, LeGrand Hunt.

Having paid their respects to Rex and his queen, the beatniks from Tooele proceeded to enliven the evening with a skit that was as "way out" as it was amusing.

Rex Rules at Mardi Gras in Utah

New Orleans' famed Mardi Gras had nothing on the ball staged by the Utah Section and the Women's Auxiliary Saturday, February 4 at the Prudential Federal Savings auditorium. Colorful costumes and unique table and hall decorations in the Mardi Gras style set the stage for the Section's Fifth Annual Miners Review featuring a social hour, dinner, queen contest, Krewes parade, and dance.

In charge of the gala affair were Alvin J. Thuli, Jr., business chairman; Karl Lacher, secretary; and Mr. and Mrs. Nevin F. Wetzel, directors. They were assisted by Mr. and Mrs. Farrell L. Alsop and Mr. and Mrs. J. A. Norden. P. H. Ensign acted as parade and program announcer and Edward Anderson was stage manager.

Reigning for the evening in the role of King Rex was Milton Williams. He and his duke attendant, Legrand Hunt, wore authentic costumes from New Orleans. Princes attending the king were Richard S. Stone and Robert C. Meyer. The queen of the ball was chosen from among the hundreds of costumed beauties in attendance. Mrs. Phil Mudgett was singled out for this honor and had as her attendant, Mrs. E. V. Hanna.

Following the true Mardi Gras tradition, six Krewes paraded through the hall, paid their respects to King Rex and his court, and presented a sketch on stage for the benefit of the audience. These ranged in theme from a show boat to beatniks. Mr. and Mrs. Sidney S. Alderman, Jr., directed the show boat scene and Larry Belk and his beatniks from Tooele were directed by Mr. and Mrs. E. W. Steinbech. Other acts included were beggars pleading to the King, presented by Mr. and Mrs. S. K. Droubay and Park City members; a circus act under the chairmanship of Mr. and Mrs. Dean D. Kerr; a takeoff on the new administration called "New Frontiers," directed by Mr. and Mrs. Richard Willey; and one based on "Around the World in 80 Days" under the guiding hands of Mr. and Mrs. Robert B. Ingalls.

The "New Frontier" pushes forward to Utah from Washington.

Balloonists prepare for "Around the World in 80 Days" take-off.

Some of gaily costumed crowd take time out for visiting with friends during Rex's reign of Misrule at the Mardi Gras ball.

Around the Sections

Continued

• The Executive Committee of the **Colorado Section** met January 4 at the University Club in Denver to discuss program planning. The basic problem, to select programs that will bring out more members to the meetings (especially the younger members), was given prime consideration. Joint meetings with the Petroleum Section, Metals Division, and the WAAIME were discussed, as were meetings to which both students and prospective students would be invited.

At the January 19 meeting of the **Colorado Section** close to 50 people attended, including two student guests. Guest speaker, D. H. Lyon of Kollstan Semiconductor Elements Inc. presented a review of semiconductor technology which brought forth a large number of questions from the audience.

• The **Ohio Valley Section** met January 19 at the Olentangy Inn, Columbus, Ohio, to hear Meno Lovenstein, professor of economics at Ohio State University, present a talk entitled *Skill and Society.*

• The **Alaska Section** held a banquet Tuesday evening, January 10 at the Traveler's Inn at which 15 members of the University of Alaska Mining Society were guests. After dinner Donald J. Cook, student counselor, introduced the four students who took part in the program. The first two papers presented by Ace R. Parker, mining, and Bert Varnell, metallurgy, dealt with the operations of United Keno Hill Mines Co. Ltd. at Elsa, Yukon Territory. Mr. Parker described mining in the underground mine plant at the Hector-Calumet mine and Mr. Varnell discussed the United Keno Hill's milling plant. The other two papers concerned the operations at the Cassiar Asbestos Co. mine at Cassiar, B.C. Lawrence E. Heiner, mining, talked about open pit mining of asbestos at Cassiar, including mining methods, geologic structure, ore reserves, and exploration program. Blair Wondzell, mining, concluded with a survey of Cassiar's rock rejection plant and mill. The presentations were accompanied by appropriate maps, diagrams, slides, and sound effects, the latter recorded at the Hector-Calumet mine.

• At the January 19 meeting of the **Hudson-Mohawk Section** held at the Van Dyck Hotel in Schenectady, N.Y., officers for the new year were elected as follows: J. Keverian, chairman; R. L. Fullman, vice chairman and program chairman; A. E. Bibb, secretary; P. Methe, treasurer; T. A. Prater, membership chairman; R. Fleischer, publicity chairman; and W. W. Dyrkacz, member-at-large and member of executive committee. Others on the executive committee are: W. Morrill, W. J. Childs, A. A. Burr, and R. E. Keith.

It was announced that the Section had paid $567, the balance of its quota, to the United Engineering Building Fund.

The program for the evening consisted of a talk by William G. Johnson, General Electric Research Laboratory, entitled *Direct Observation of Dislocation Properties.*

• Herbert Hawkes of the University of California was guest speaker at the January 11 meeting of the **San Francisco Section.** He presented an illustrated talk on the outlook for and practical use of geochemical prospecting.

• Thirty-four members of the **Morenci Subsection** (Arizona Section) gathered at the Longfellow Inn on Tuesday evening, January 17, for a cocktail hour and dinner meeting. Following dinner, John Schneider, lubrication engineer, Texaco Inc., presented a motion picture entitled *Sheer Magic,* which described the compounding and testing of more than 100 different types of greases for the many different requirements of modern industry.

• For the 35th time in as many years, members of the **Washington, D. C. Section,** undeterred by the threat of the weekly snow storm, enjoyed a feast of oysters at their annual social, February 7. During the cocktail hour oysters on the half shell were served. At the buffet dinner held in the dining room of the Broadmoor Apartment Hotel, oyster stew, panned oysters, and fried oysters were featured. The menu also included assorted cold cuts, cheeses, salads, old-fashioned apple pie, and coffee or tea.

• Nearly 75 people attended the February 1 dinner meeting of the **Chicago Section** held at the Chicago Bar Association. W. S. Lowe, president of A. P. Green Fire Brick Co., in a talk called *Why the Engineer,* discussed the changing role of the engineer and his ever-increasing responsibilities.

Around the Sections

Continued

• **The Adirondack Section** announces the following officers for 1961: George Erdman, chairman; Patrick Farrell, vice chairman; and Thomas J. Leonard, secretary-treasurer.

• Nearly 50 people attended the January 12 meeting of the **Ajo Subsection** (Arizona Section) at the Copper Coffee Shop. Two staff members of the Western Div., Phelps Dodge Corp., told about the development of a gas reformer at the Douglas Smelter which produces a reducing gas to replace poles in the reduction of copper.

• **The Wisconsin Section,** established June 21, 1960, is the latest addition to the roll of local sections. The group's official year began with the January 26 meeting, which opened with a social hour followed by a prime rib dinner at the Black Steer Restaurant in Milwaukee. During the business meeting after dinner the officers for 1961 were announced: T. G. Kirkland, chairman; R. A. Dodd, 1st vice chairman; J. W. Snavely, 2nd vice chairman; J. B. Calkins, secretary; Edwin Sweetman, treasurer. Directors for one year are J. K. Gibson and W. J. Cherones, and directors for two years are R. R. Blackwood, H. W. Buus, and R. G. Schaal. In a talk from the floor, Will Mitchell, Jr., discussed the importance of the U.S. mining industry as a part of the total national product and its importance in international trade. He then went on to outline the decline of mining schools in the U.S., pointing out that it is the direct responsibility of AIME to stop this decline.

The evening's program featured a talk entitled, *Unlimited Energy from Nuclear Fusion-The C-Stellaraton Project* by L. J. Linde, manager of C-Stellarator Associates and director of engineering services for Allis-Chalmers Mfg. Co.

• The January meeting of the **Montana Section** was held jointly with the Montana Society of Engineers on January 26 at the Montana School of Mines in Butte. The main speaker of the evening was G. W. Ferguson, senior technologist, Pacific Coast Region, Texaco Inc., who presented an illustrated talk entitled, *Some Compressor Lubrication Problems.* The talk dealt chiefly with the study and prevention of inflammable reactions of lubricants in crankcases of compressors. The discussion which followed the talk brought out the point that the same principles involved in compressor crankcases are applicable to automobile crankcases, but since the operating temperature of auto crankcases is lower, the problem of inflammable reaction is diminished.

• The **Lima, Peru** section held its monthly luncheon meeting January 18 at the Hotel Bolivar. The speaker on that occasion was Russell Kohn, vice president and resident manager of Marcona Mining Co., who discussed the development of the Marcona iron deposit. Motion pictures taken during the meeting were later shown on a T.V. news program.

Will Mitchell, Jr. addresses the Wisconsin Section informally from the floor.

W. L. Bradshaw's solution to the problem of the treasury of the newly formed Wisconsin Section was as direct as it was effective—a Sunday morning-type collection with a request that each member give a dollar. From left to right Edwin Sweetman, W. L. Bradshaw, T. G. Kirkland, and J. W. Snavely discuss allocation of the proceeds.

Amid much joviality a member adds to Bradshaw's collection.

Conversation proved lively during the pre-dinner social hour.

Personals

J. G. ROESCHLAUB

W. BOURRET

H. W. STRICKLAND

C. F. FOGARTY

John G. Roeschlaub has been appointed sales engineer for Mine & Smelter Supply Co., according to an announcement from Donald J. Drinkwater, manager of the company's manufacturing division. Prior to joining Mine & Smelter Supply Co., Mr. Roeschlaub was metallurgist for Southern Peru Copper Corp. at the new plant in Toquepala.

The election of **Weston Bourret,** mining geologist, as vice president of Utah Construction & Mining Co. was announced recently. Mr. Bourret has been with the firm since 1952, serving as manager of the mineral development and geology department, and will continue in that post.

Robert M. Hurst, general superintendent for Standard Metals Corp., is now in charge of all base metals operations, spending most of his time in Silverton, Colo., where the company is operating the Shenandoah mine and mill and developing the Sunnyside mine.

A. M. Wells, formerly assistant mine superintendent with Nickel Processing Corp., is presently a construction engineer with the U.S. Army Corps of Engineers working on Canyon Dam.

R. F. Wesner has taken a position as consulting engineer with McNally Pittsburg Mfg. Corp. He was formerly vice president—operations and general manager of Boone County Coal Corp.

Arlen R. Bock, recently inducted into the army, is serving as civil engineering assistant at the U.S. Army polar research and development center, Ft. Belvoir, Va. He was formerly assistant mining engineer with Cordero Mining Co.

After almost ten years in the employ of Potter & Sims Mines as engineer and superintendent, **Leonard Parker** has joined Fenix & Scisson Engineering & Construction Co. as project manager. The company is engaged in the construction of underground storage caverns for liquified petroleum gas.

Texas Gulf Sulphur Co. recently named **Hugh W. Strickland** and **Charles F. Fogarty** as senior vice presidents. They had previously been vice presidents. Mr. Strickland will be in charge of sulfur production and, in the Gulf Coast region, of all other corporate activities as well. He has been associated with the company since 1928. Mr. Fogarty will have responsibility for Texas Gulf's exploration activities and for the company's new $25 million potash project in Utah. He has been with the firm since 1952, when he joined the Houston office of the exploration department.

M. J. Cruickshank, who for five years has been mine manager for Muirshiel Barytes Co. Ltd., Renfrewshire, Scotland, has received a research fellowship to the Colorado School of Mines Research Foundation Inc. to carry out research on mining problems in the littoral regions.

Ernst P. Hall, research consultant, Consolidation Coal Co., has been named chairman of the coal subcommittee of the Air Pollution Control Assn., and **Harry C. Ballman,** manager of National Coal Assn., Air Pollution Control Div., has been appointed chairman of the coal utilization subcommittee. These subcommittees to the organization's technical council are established to develop reports on procedures and methods of controlling known air pollutants from industrial sources.

Max A. Tuttle retired from Pickands Mather & Co. at the end of 1960. He continues to make his home in Indianapolis.

M. A. Hanna Co. recently announced the transfer of **John C. Hagen** from the Midwest Ore Co., Iron Mountain, Mo., to the company's office in Iron River, Mich.

J. J. Mastrovich has returned from Lima, Peru, to take a job with Gardner-Denver Co. at Quincy, Ill.

When the sales department of the Reich Drill Div. of Chicago Pneumatic Tool Co. moved from Terre

Haute, Ind., to the plant location in Franklin, Pa., **Wendell L. Reich,** president of the division, also moved to Franklin to make his headquarters there.

A recent announcement from American Metal Climax Inc. reported the election of two vice presidents, **Thomas W. Childs** and **Wallace Macgregor,** to the Board of Directors. They fill the vacancies left by the death of Hans A. Vogelstein and the resignation of Weston G. Thomas.

Leonard C. Clark has opened a consulting business in Tucson, Ariz., after eight years with Utah Construction & Mining Co. as chief engineer and geologist.

Paul D. Chamberlin, formerly a trainee with Oliver Iron Mining Div. of U.S. Steel Corp., is presently serving in the U.S. Army as automotive maintenance and repair officer.

John K. Gustafson became president of Homestake Mining Co. at the beginning of this year, succeeding **D. H. McLaughlin,** who became chairman of the Board. Before assuming his new position Mr. Gustafson had been vice president of The M. A. Hanna Co., with which he has been associated since 1950. Immediately prior to coming to Hanna, he was with the U. S. Atomic Energy Commission in Washington, D. C., where in 1948 he was director of Raw Materials and in 1949 manager of Raw Materials Operations. From 1950 to 1959 he served as a member of the Advisory Committee for Raw Materials of the U. S. Atomic Energy Commission.

Mr. Gustafson has a broad background in geology and exploration with a number of mining companies. Early in his career he directed the exploration undertaken by Hollinger Consolidated Gold Mines Ltd. that led to the development of the iron fields in Laborador, Quebec. He has been associated with the geological investigation of the Broken Hill lead-zinc field, the acquisition of the San Manuel copper deposit by Magna Copper Co., and the initiation of Newmont Mining Corp.'s successful lead-zinc operations in Morocco. In recent years the Brazilian iron ore and bauxite projects, the St. John d'el Rey gold mine in Brazil, and the Guatemala nickel project occupied much of his time.

K. WILSON

L. T. BROWN

Kenneth Wilson, for the past 17 years exploration geologist for American Smelting & Refining Co., has resigned to open consulting offices in San Francisco at 400 Montgomery St. and in Menlo Park, Calif. He had been in charge of the American Smelting & Refining Co. West Coast exploration office and was the company's specialist in problems of ownership and acquisition of property for exploration. He recently returned from a year's work on various land problems in the eastern and southern states.

Leroy T. Brown terminates six years of service as general manager of Amveco C. A. in Venezuela with the liquidation of that company's asbestos mining and milling enterprise this month.

David L. Hodgson, formerly a junior industrial engineer with Alabama Power Co., has become a geologist on the fuel planning staff of the TVA.

Hugh Thomas Logue has moved from Sullivan, Mo., where he had

Eugene D. Gardner, *left, retired chief mining engineer of the USBM, is congratulated by* **Marling J. Ankeny,** *director of the Bureau, on receiving the University of Arizona's Award of Merit for notable contributions to mining in the Southwest.*

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personals

continued

been working as a gravity meter operator for Thomas Bevan Geophysical Co., to the West Coast to take a job with Fairchild Aerial Surveys Inc. as sterotop operator.

After many years in South America, the last five in Venezuela with the Orinoco Mining Co., **Edgar O. Marty** has retired to Boca Raton, Fla., where is is presently available for consultation.

Philip DeF. Bleser has recently been registered as a professional mining engineer in the state of Vermont.

M. A. Burke, manager of Cía. Minera Chocó Pacífico, S.A., Andagoya, Colombia, has been named assistant vice president of South American Gold and Platinum Co.

Ernest A. Arvidson has transferred from Fagersta Steels Ltd., Toronto to Fagersta Bruks AB, Fagersta, Sweden.

Recently, Pickands Mather & Co. announced three new appointments affecting the company's Mesabi range operations in Minnesota. **Robert W. Bell,** who has been superintendent of pits at the Erie Mining Co., Hoyt Lakes, Minn., has been transferred to the company's Cleveland Office. In his new capacity Mr. Bell is in charge of investigations of potential new mining properties for the company. **Walter L. Thomte** becomes superintendent of mining at Hoyt Lakes. He had been superintendent of the Lake Mining Co., Biwabik, Minn. **James E. Schelske,** formerly superintendent of the Bennett Mining Co., Keewatin, Minn., has been transferred to the Erie Mining Co. as assistant superintendent of mining.

Donald W. Lindgren and **Ernest K. Lehmann,** Lindgren & Lehmann consulting mining geologists of St. Paul and Minneapolis, announce that they have formed association agreements with Hansen Associates, consulting geophysicists in Salt Lake City, and Greenacres Inc., consulting foresters in Seattle. These agreements result in a pool of specialized technical services available to the mining, timber, and related industries and to owners of undeveloped land.

Henry G. Fisk, formerly with the Natural Resources and Research Institute, University of Wyoming, has accepted an appointment to the geology department staff of the Montana School of Mines in Butte.

S. K. DROUBAY

F. C. GREEN

J. P. O'KEEFE

M. P. ROMNEY

At the annual meeting of the Utah Mining Association, officers for 1961 were elected as follows: **S. K. Droubay,** president; **F. C. Green,** 1st vice president; Mitchell Melich, 2nd vice president, and **J. P. O'Keefe,** 3rd vice president. The staff has been sustained for the coming year: **Miles P. Romney,** secretary-manager; **Walter M. Horne,** assistant secretary-manager; and **Mildred E. Hollberg,** office secretary.

P. J. Cunningham has been transferred to the International Sales Dept. of Ingersoll-Rand Co. in New York from Caracas, Venezuela.

Luis A. Nogales, who has been doing mine examination work in Bolivia for a number of months, has moved his headquarters to La Paz, Bolivia from Lima, Peru.

Upon graduation from the Missouri School of Mines in January, **Arnaldo Salazar** accepted a position with the Venezuelan Government Ministry of Mines and Hydrocarbons. His work is chiefly concerned with gold vein production for the government-owned mines in the state of Bolivar in southern Venezuela.

W. E. Danver has been transferred from the El Paso district office to the San Francisco district office of Worthington Corp.

John F. Haynes has gone from Honduras to Lima, Peru, where he is engaged in a minerals exploration program for Utex Exploration Co., the same company with which he was associated in Central America.

Nuclear Science & Engineering Corp. of Pittsburgh recently announced that **Harold J. Rose** will be associated with the firm as consultant. Mr. Rose is well known as an authority on coal research and engineering development work. Recently he acted as principal investigator for the Atomic Energy Commission—Bituminous Coal Research Project on potential applications of radioisotopes within the coal industry in cooperation with Nuclear Science & Engineering Corp.

Harold C. Carter has gone to Bogota, Colombia, as a petrographer for Servicio Geologico Nacional, Minesterio de Minas de Colombia. He was formerly assistant mining superintendent for Alcoa Exploration Co.

After two years as technical assistant with Hopkin & Williams (Travancore) Ltd., in South India, **J. K. Almond** has accepted a three-year contract with the Geological Survey Department of Uganda, East Africa, as mineral dresser. Between assignments, Mr. Almond spent a leave in England, where he attended the Mineral Processing Congress.

Gilbert G. Rodrigues has moved to Hanover, N.M., where he is chief mining engineer for Peru Mining Co. He was formerly chief of planning for Lance Engineers Inc. in El Paso, Texas.

J. G. D. Crone has taken a position with The Zinc Corp. Ltd., Broken Hill, N.S.W., following completion of his studies at the University of Melbourne. He is currently gaining practical underground experience for a year, a requirement for a mine manager's certificate.

After 14 years with Calumet & Hecla as a mechanical superintendent, **R. Robbins Spencer** has gone with Langer Equipment Co. as manager of sales and service of mining machinery, equipment, and supplies on the Mesabi and Cayuna Ranges of Minnesota.

William Carty has been transferred from Reynolds, Pa., where he was mining engineer for Atlas Powder Co., to the company's Knoxville, Tenn. office as sales engineer. He will be representing the company in southern West Virginia and southwestern Virginia.

K. J. Whiter, who was mill superintendent with Uruwira Minerals Ltd., Tanganyika, East Africa, left after 11 years of service upon the liquidation of the company in June 1960. After a big game photography safari in East Africa, and a further vacation on his return to Australia, he took a position of deputy mill superintendent with Territory Enterprises Pty. Ltd., Rum Jungle, Northern Territory, Australia.

After five years as geologist in the New York office of American Smelting & Refining Co., **Salvatore A. Anzalone** has been transferred to the company's Silver Bell unit in Arizona.

R. J. Armstrong has been appointed manager, Exploration Div., The Consolidated Mining & Smelting Co. at Trail, B.C.

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personals

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H. B. James has been appointed secretary-treasurer and director of American Exploration & Mining Co., a wholly-owned subsidiary of Placer Development Ltd. He replaces **D. de S. Duke,** who has retired after 27 years with the Placer group of companies.

A. H. Kapadia has accepted a position as assistant general manager with Lampa Mining Co. Ltd. in Peru. He had previously been associated with Barymin Explorations Ltd. of Toronto.

W. B. Hall, who had been mill superintendent at Messina, Northern Transvaal, has been transferred by Messina Transvaal Development Co. Ltd. to its newly opened Alaska mine in Southern Rhodesia as mill superintendent.

Lewis C. Black, vice president in charge of sales for Bucyrus-Erie Co., was recently elected president of the Power Crane and Shovel Assn. for a one-year term.

L. C. BLACK

H. S. FOWLER

Hedley S. Fowler has returned to Berkeley, Calif., following completion of an assignment for Kaiser Engineers as engineer in charge of site investigation for the one million-horse power dam of the Volta River project in Ghana. He returned via South Africa and Europe, visiting mines in Johannesburg and Rhodesia and the Kariba and Aswan dams.

After two years as an engineering scientist at the Allis-Chalmers Research Laboratory, **E. S. Rousseau** has gone to work as assistant mill metallurgist for the Chino Mines Div., Kennecott Copper Corp.

O. David Neidermeyer, Jr. has left Braden Copper Co., where he has been employed as a planning foreman for the past two years, to take graduate work at Stanford University. He is working toward an M.S. degree in mining engineering with emphasis on business courses.

J. Douglas Bell, formerly located in Grand Junction, Colo., as explora-

tion geologist for Hecla Mining Co., has been transferred by the company to open an exploration office in Tucson, Ariz.

David W. Stevens, who has been a trainee with Bethlehem Mines Corp., is on leave of absence to attend Wharton School of Finance, University of Pennsylvania, where he is studying for an M.B.A. degree in industrial management.

The following changes in the organization of the Sandvik group of companies was announced recently: **Lars de Jounge,** technical representative for Sandvik Coromant rock drill steel products in the U.S. and Canada, has been appointed general manager for a new company in India, Sandvik Asia Ltd. The company will manufacture tungsten carbide and rock drill steel products at a plant in Poona, approximately 100 miles from Bombay.

Carl Ake Janson, previously mine superintendent at KIRUNA iron ore mine in Sweden, has been named technical representative for Sandvik Coromant rock drill steel equipment. He will make his headquarters with Atlas Copco, Paramus, N.J.

J. F. Wickham has been promoted from general superintendent of the Chilete Unit (Northern Peru Mining Corp., a subsidiary of ASARCO) to assistant manager of the unit.

J. E. Cleveland has joined Kermac Nuclear Fuels Corp. as a mining engineer. He was formerly a sales engineer for Ingersoll-Rand Co.

Roger R. Nelson, assistant professor in the mining and metallurgical department of the College of Engineering, University of Wisconsin, has returned to his post after a leave of absence during which he was a fellow at the University of Arizona.

H. N. PROPP

S. C. MCCOMB

J. W. MCMANAWAY

P. V. BETHURUM

According to a recent announcement from Nordberg Mfg. Co., the following appointments have been made in the Crushing and Process Machinery Div.: **Harold N. Propp,** formerly assistant Western Branch manager, has been appointed Western Branch manager in the San Francisco office, replacing **T. D. Davis,** who will continue in the office as consulting branch manager. **S. C. McComb** has been named manager in the Vancouver, British Columbia office. He had been Western Canadian representative of Nordberg's Engine Div. for the past nine years. **James W. McManaway,** who recently joined Nordberg, has been assigned as a sales engineer in Roanoke, Va. as representative for the southeastern states.

P. V. Bethurum has been appointed mill superintendent of the Texas uranium mill of Susquehana-Western Inc. He started with the company in 1957 at the Edgemont, S.D. mill and in 1958 became production foreman of the Riverton, Wyo. mill.

Stephen F. Dunn *(left, with unidentified participants) president of the National Coal Assn., at the Tripartite Technical Meeting of the International Labor Organization in Geneva, Switzerland, advocates exchange of research information among coal producing and consuming nations through an existing international office.*

Obituaries

Rollin Anthony Pallanch

An Appreciation by
R. N. Hunt

Rollin Anthony Pallanch (Member 1925) died of a heart attack Sept. 29, 1960, at his home in Salt Lake City after spending the morning doing routine chores around the yard.

He was born in Fredonia, Wis., Aug. 4, 1891 and graduated from the University of Wisconsin in 1915 with the degree of mining engineer. In the same year he married Agnes Crawley of Marinette, Wis., and went West to work in the metallurgical laboratory. In 1929 he became superintendent of the plant and in 1950 consulting metallurgist, which position he held until his retirement in 1954.

For short periods he superintended and advised other mills of that company. For a period in 1922 he was superintendent of the cyanide mill of the Portland mine, Victor, Colo.

The considerable volume of custom ore treated at U.S. Smelting's Midvale mill for many years afforded a unique experience in the treating of a wide range of western base metal ores. Pallanch saw the conversion of the Midvale plant from gravity and Huff-static equipment to a differential flotation plant treating complex lead, zinc, and copper ores. The Midvale concentrator was one of a few in the western states and Canada which pioneered in the development of selective flotation as applied to base metal ores. He developed rare skill and judgment in determining methods of handling ores and their availability and evolved and patented the use of sodium sulfite as a reagent in the separation of lead and zinc in sulfide ores. He contributed numerous papers to technical journals and wrote the chapter on the concentration of zinc ores in **Zinc**, a volume on the technology of that metal and its alloys recently published by the American Chemical Society in collaboration with the American Zinc Institute.

Those who worked with him most respected him for the gentleman he was, for his absolute integrity, unfailing fairness, and devotion to duty.

Benno Elkan (Member 1912) died Jan. 6, 1961, at the New Rochelle Hospital at the age of 85. Born in Frankfurt, Germany, Mr. Elkan went to work for Beer, Sondheimer & Co. of Frankfurt at the age of 16. In 1906 he came to New York City to head the company's branch office. After World War I he became vice president of International Minerals and Metal Corp. and subsequently president. At the time of his retirement ten years ago he was chairman of the board. In the course of his career he had also served as president of National Zinc Co., Bartlesville, Okla., and governor of New York's Commodity Exchange.

Robert E. Illidge (Member 1948) died at the Veterans Hospital, Fayetteville, Ark., Dec. 20, 1960. He was born in Portland, Ore., Oct. 17, 1898. Following graduation from the Missouri School of Mines in 1920, he started work for The Eagle Picher Co. He held various positions in the mining division at Picher, Okla., and at the smelters and manufacturing plants at Galena, Kan., and Joplin, Mo. At the time of his death he was senior engineer in the research department.

Emory T. Miller (Legion of Honor Member 1903) died Dec. 26, 1960, at the age of 81 in Lafayette, Calif. Mr. Miller was born in Louisville, Ky., on Sept. 18, 1879. He attended Lehigh University at Bethlehem, Pa., where he studied mining engineering and graduated in 1903. He was a member of Beta Theta Pi fraternity. He began his career as a mining engineer with the United Fruit Co. in South America. He was later employed by the Woodward Iron Co., Woodward, Ala., and Manhattan Rubber Co., Passaic, N. J. During World War II he worked for the War Production Board in Washington, D. C.

Harry A. Treadwell (Member 1942) 75, who retired in 1954 as vice president—operations of the Chicago, Wilmington & Franklin Coal Co., after many years with the company died in his sleep during the night of Dec. 16, 1960, in the Cornhusker Hotel, Lincoln, Neb. He was visiting friends in Lincoln en route to California, where he planned to spend Christmas with a daughter. Mr. Treadwell was born in Elgin, Ill., on Christmas, 1884. He was a graduate of Virginia Polytechnical Institute. Following graduation he went to work as a junior engineer in the U.S. Reclamation Service. In 1916 he began his association with Chicago, Wilmington & Franklin Coal Co. as top foreman. Following his retirement he established a consulting practice in Chicago.

A. R. Walter (Member 1916) died Oct. 13, 1960. Mr. Walter was born in Winona, Minn., in 1892. He received his professional training at the Michigan College of Mines. Following graduation he went to work for Pennsylvania Steel Co. in Lebanon, Pa., and the next year joined Bethlehem Steel Co. as assistant superintendent at the company's concentrating, nodulizing, and sintering plants in Lebanon. He remained with the company until shortly before his death.

Edward R. Navrocky (Member 1930) died Dec. 5, 1960. He was born Jan. 3, 1907, in Throop, Pa, and was a graduate of Pennsylvania State College.

Frank W. Millard (Member 1934), 80, died July 8, 1960, in Youngstown, Ariz. He was born in Burden, Kan., and was a graduate of the Colorado School of Mines. Following his graduation he worked for a couple of gold mining companies in Telluride, Colo. For many years he maintained his own firm of F. W. Millard & Son, Ely, Nev. He had retired to Arizona shortly before his death.

Necrology

Date Elected	Name	Date of Death
1928	Louis H. Bean	Unknown
1909	Ernest F. Burchard (Legion of Honor)	Feb. 1, 1961
1941	Louis Garbrecht	Feb. 12, 1961
1907	Cyril W. Knight (Legion of Honor)	Oct. 13, 1960
1902	Alex. Laggat (Legion of Honor)	January 1961
1918	W. P. Putnam	Jan. 26, 1961

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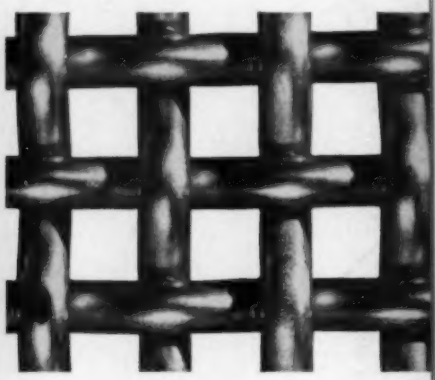

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